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THIRTIETH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

Those would indeed be hard to please who gave expression to words of fault finding over the initial scenes and indications respecting the Thirtieth Annual Meeting of the American Gas Light Association, the technical sessions of which were brought to a close at 2 P.M. this afternoon—Thursday, the 16th inst. Greater New Yorkers have had about as mean a stretch of bad weather as it is possible to experience "in these parts," for well into the last half of September, and again in the first half of the current month; rain, rain, all the time rain. But as all disagreeable things must come to an end, luckily for plodding humanity, the weather man at last gave us relief. The day and evening preceding the meeting were all that could be asked or even hoped for, so far as atmospheric conditions went, and those who came in from afar, on reaching headquarters at the Plaza Hotel, congratulated the natives on the luxury of having such a climate. The early birds at the Plaza were many, and although some trouble was experienced by a few in securing suitable living apartments, no one really suffered on such account. Headquarters were voted amply sufficient, the location was undeniably convenient of access from the different parts of the city, and the proximity of the meeting room (the handsome, spacious apartment in the house of the New York Athletic Club, known as the "Green Room") to headquarters was appreciated by all. Another feature that appealed to those who attended the technical sessions closely was the quiet that prevailed, for 59th street, between Fifth and Sixth avenues, has little of the doings of busy commerce to disturb its calm. That the many who reported at the Plaza Hotel the evening of October 14th presaged a good attendance was well borne out next morning, when at 10 o'clock the President, Mr. William R. Beal, of New York city, formally called the convention to order. Trim, soldierly and brisk, President Beal soon had the regular order of the sessions well underway. Of course, he was flanked on either side by Secretary Forstall and Recorder Davis—the latter has "assisted" at many a meeting of the American Association. The first thing to engage attention was the report of the Council, in respect to the membership portion of its duties. It was known that a great increase in the membership was to be made at this meeting, but we venture the assertion that no one was prepared for the actual result. No less than 101 were proposed for the active class, and 19 for the associate division. The applicants having been regularly elected, the Association, as per recommendation of the Council, performed a most graceful act in the naming to honorary membership of Mr. A. B. Slater, Sr., of Providence, R. I., who in the days gone by was a tower of strength to the Association, either as committeeman, paper contributor, officer or entertainer—Mr. Slater was the 10th President of the Association. The acclaim that greeted the announcement of his selection was ample proof that the man and his services were remembered. The balance of the report of the Council had largely to do with propositions to amend the Constitution, but the "repairs" are largely of a minor character. Then followed the reports of Mr. Forstall as Secretary and Treasurer, and the report of the Trustees of the Educational Fund. The latter document was seemingly satisfactory to the Trustees, and as there never came advantage out of "Trying to be more Catholic than the Pope," it would appear to be the duty of the Association, and of the ordinary contributors

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to the fund as well, to hold that sufficient good has been derived from the administration of the fund in the shape of tuition, even if the cost of the latter does seem rather high. The report of the Committee on Nomination of Officers was next taken up. The names submitted were the following:

President.—A. S. Miller, New York city.
First Vice-President.—Rollin Norris, Philadelphia, Pa.
Second Vice-President.—E. G. Cowdery, Milwaukee, Wis.
Third Vice-President.—Chas. F. Prichard, Lynn, Mass.
Secretary and Treasurer—Alfred E. Forstall, Montclair, N. J.
Members of Council (terms expire 1904).—David H. Geggie, Quebec, Can.; R. M. Searle, Mt. Vernon, N.Y.; F. H. Shelton, Philadelphia, Pa,. and W. P. Knowles, Richmond, Va.

It is needless to say that the gentlemen named were elected unanimously, and the selection of the brown-eyed gentleman from Lynn as the last in succession to the presidency seemed to give especial satisfaction. President-elect Miller, in responding to his promotion in a cleverly set speech, betrayed not the slightest symptom of the fact that he was between two stools (each of them pretty high) as to whether he would assume the post of General Manager to the Consolidated Gas Company, of Baltimore, Md., or remain as he is, Superintendent of Construction to the Consolidated Gas Company, of New York. Mr. Prichard also made a commonsense acknowledgment of the Association's preferment of him. These necessary formalities having been recorded, Vice-President Miller assumed the Chair and President Beal read his presidential message. The address is a commonsense, practical, well put together document, and we are quite close to the facts when we say that its sensible paragraphs will be read with profit and pleasure equal to that of those who had the satisfaction of listening to its composer deliver it. Much of it is devoted to comment on the inclined system of retorts, two different types of which are now being installed on a fairly large scale in the plant of the works, the destinies of which have been successfully controlled and directed by Mr. Beal for many years—the plant in Northern New York city, now operated by the interest known as the Central Union Gas Company, of which Company Mr. Beal is President. While the references in the address to the inclined system are lengthy, they by no means form its salient points, for in it many matters of general interest are entertainingly presented. The President on concluding his message, was greeted by a round of hearty applause. The address having been referred to a committee in the usual way, the Association listened to a lengthy and complete report from the committee named to consider and report upon a uniform system of accounts for gas companies, which report was discussed in a most complimentary strain. In this hasty notation of the committee's findings it is only necessary to say that the gentlemen who prosecuted those dry researches to such a successful termination well deserved the hearty vote of thanks that was passed to them. Vice-President Miller, on behalf of the committee on research, presented a verbal report of what had been done by the members thereof during the year. The report showed that something had been done, but the doings were in such embryotic stage that the committee virtually only reported progress. The Secretary then announced the reception of many letters from men prominent in the fraternity who regretted that time to be put in other duties prevented them from attending the sessions. Then followed two invitations, which were heartily accepted. The first was from Constructor-in-Chief Jno. B. McDonald, of the great subway now in process of construction in the city, and which construction has given New York the appearance of being in a transition stage for months. The members were at liberty to go through the workings as they listed; the Association badge was the only symbol of identification needed. The other invitation was from the Metropolitan (or Interurban) Street Railway Company to inspect its magnificent new power station on the upper East Side. As in the subway case, the button was the proof that the visitor was welcome. The paper list was now reached and the first number was the communication by Mr. I. N. Knapp, of Philadelphia, entitled "Some Notes on Cement Masonry." Mr. Knapp's subject was a fairly new one for discussion before a gas association on this side of the water, but that it had interest for the members was shown in the good discussion that it brought about. He treated the matter in the careful way that marks all his work, and his paper will often be referred to by those who have to deal practically later on with that to which it refers. The next paper was on "The Care and Maintenance of Incandescent Gas Burners," by Mr. McDougald Dexter, of Columbus, Ga. In the absence of the author the paper was read by Mr. James Ferrier. It was a practical treatise all the way through, and the discussion that followed would have been much lengthier were it not for the fact that the majority of the members were in good accord with the author's ideas. The hour for adjournment (2 P.M.) having been reached, the sessions for the first day were declared at an end. The programme this year was so arranged that one long session (from 10 A.M. to 2 P.M.) was devoted to the day's work, instead of the usual rule heretofore in having a morning and an afternoon session, the luncheon time intervening. The change was a good one and seemed to hold the members close in attention during the business time.

The second day's session was called to order at 10 A.M. of the 16th, and the proceedings were opened by the reading of the paper by Mr. George McLean, of Dubuque, Ia., the title of which was "Gas Rates and a Franchise Tax." In the absence of Mr. McLean the paper was read by Secretary Forstall. Its text, which will be found in this issue of the JOURNAL, is of the kind that Mr. McLean knows so well how to prepare; thoughtful, precise and clear. Next followed the report from the committee on national advertising, which was read by Mr. E. G. Pratt, the voice of the Chairman (Mr. F. D. Moses) of the committee having for once failed to stand by him. That the committee had evidently been hard at work, and intelligently too, is shown by the recommendations made in the findings submitted. The Consolidated Gas Company here extended an invitation to the Association to take a trip on the East and North rivers for the purpose of inspecting several of the Company's gas and electric stations, stops to be made at such points as the party wished. The start was to be made at 10 A.M of the 17th inst., from the magnificent station of the New York Edison Company, on the East river front, between 38th and 39th streets. The Manhattan Railway Company also invited the Association to inspect its new and imposing electric station, now in process of completion—the Company, which operates the elevated railway system in the city, will shortly dispense with steam for motor purposes completely. The next paper read was the one by Mr. George S. Clarke, of Kansas city, Mo., whose subject was "The Cleaning and Repairing of Gas Stoves," Unfortunately the author was prevented by illness from attending the meeting, and his communication was read by Mr. Rollin Norris. The committee appointed to select the next place of meeting reported in favor of Detroit, which recommendation was adopted. Mr. R. B. Brown, of Milwukee, Wis., here read his paper in explanation of "Why Milwaukee Did Not Build Inclines." Its lines and reasons evoked a brisk discussion, and at the termination thereof it seemed that the Association stood about equally divided as to the merits of Mr. Brown's arguments. The report of the committee on President's address was then read and received, after which came the last paper on the list, that by Mr. W. Cullen Morris, of Ravenswood, Long Island City, whose notes on "A Test of a High Candle Power Incandescent Gas Lamp" were of much interest, and gave abundant evidence of the thoroughness with which his examinations had been conducted and of the great amount of labor these entailed. We predict that Mr. Morris will be heard from prominently in the gas world if he elects to keep on therein. The Question Box was then disposed of—its contents were not voluminous—after which the committee to award the Beal medal, for the most meritorious paper read at the 29th meeting, reported that the judgment of the committee was that none of the papers then read were quite up to the standard governing the conditions of the awarding of the prize. A hearty vote of thanks was then passed to the officers and to the local committee of arrangements for their arduous and successful labors in causing the 30th meeting of the Association to be in every sense useful and enjoyable. At 2 P.M. President Beal declared the business sessions at an end. The entertainment provided for the ladies in attendance (they numbered over 100) was quite to their liking. Thursday afternoon (and the weather was perfect for such an outing) carriages conveyed them through Central Park, on to upper Riverside Drive, to the monument of the illustrious hero of the War of the Rebellion—General Grant—and other points of interest in the city. To-night (Thursday) while the sterner sex will be enjoying a banquet in the Green Room of the New York Athletic Club, the gentler members are to have a night at the play. The committee of arrangements, led by Mr. E. E. Witherby and Captain White, simply did not miss a chance to do the right things at the right times.

The banquet last night was in every sense a success. About 250 shared in its pleasures, and good cheer, well served in the Green Room of the Club House, was the portion of those who shared in the festivities. The proceedings were under the direction of President Beal and President-elect Miller, with Captain White as Master of Ceremonies. Music, recitations and repartee assisted in the passing of a very pleasant three hours—the guests entered at 8 P.M. and filed out at 11 P.M. A notable "story" was one told by Mister Eaton, of Chicago. The ladies thoroughly enjoyed their night at the play.

The river trip was started this morning (Friday) under the most depressing weather conditions. A raw, northeast wind prevailed, and the atmospheric color was of the sort that meant natural fog well mixed with puffs from the chimneys that have been serving out for some time the products that go with the combustion of bituminous coal. The Consolidated Company as hosts had everything in good shape for the "voyage," and a large delegation went aboard at the appointed hour.

Gas Rates and a Franchise Tax.

[A paper read by MR. GEORGE MCLEAN, of Dubuque, Ia,, at the Thirtieth Meeting of the American Gas Light Association, New York, Oct. 15 to 17, 1902.]

Taxation of gas companies and public control of rates are related questions under the laws of Iowa, for the reason that the laws of our State provide for the taxation of the franchises of public service corporations, and provide also for public control of the rates of some of them. Under our Iowa statutes the city council is empowered to regulate the rates of gas and electric light companies as frequently as it chooses, and it may not contract away this right. It may contract to pay a certain price for public service for a number of years, a lower court has held, and it may prescribe the maximum charge for domestic service; but it may not guarantee that this maximum charge will not be altered during the life of the charter. The obvious purpose of this statute is to protect the public against the incapacity or dishonesty of its own agents; against contracts authorizing extortionate charges for domestic service The objection made is that it exposes lighting companies to blackmail and to the attacks of the malicious and prejudiced. Our own experience is that it does not increase the danger from these sources, by comparison with charters providing for readjustment of rates at certain fixed intervals. Under the Iowa law the life of the charter is limited to 25 years. If we could have a law fixing rates for the entire period of the charter, we might prefer that as offering an absolute guarantee against persecution in the form of attacks on rates. However, public sentiment is such that the choice seems to lie between a statute empowering the council to readjust rates for domestic service at any time, and a contract providing for readjustment at intervals not exceeding 5 or 10 years. We prefer the Iowa statute because, in practice thus far, it has meant no regulation of rates except by competition. When the contract provides for readjustment of rates every 5 or 10 years, the company is forced into politics periodically to protect itself against possible injustice. During the existence of the Iowa law but one attempt has been made to regulate our rates. It was not made in response to public demand, but to gratify malice. We protested that the power to regulate rates is a reserved power, granted to the city council for the purpose of protecting the public against monopoly, that competition with other illuminating and heating agents is the best regulator of rates, and that where such competition was present, as in the lighting business in Dubuque, arbitrary regulations could not be justified.

The justice of our protest and the absence of public demand for the exercise of the council's power were so apparent that the author of the proposition, to regulate our rates by ordinance, withdrew it. And while the statute has given us no trouble, except in this single instance, when the attack was so easily repulsed, it has given us an argument against the raiding company seeking admission to our field. It has enabled us to answer, if asked why a second company should not be admitted to our field, that if our rates are reasonable the public interest does not require the chartering of a second company, and that if our rates are unreasonable then, also, the public interest does not require the chartering of a second company; because the remedy lies not in duplicating the service, an expensive process for the public in the end, but in reducing the rates of the established concern to a reasonable basis, which the council in Dubuque has power to do. The statute affords us no guarantee that the council will not charter a second company, and as a matter of fact competing companies have been chartered in a few cities of Iowa since this statute was adopted; but it supplies a reason why the service should not be duplicated, and appeases public sentiment in favor of duplicating it, thereby increasing the liberty of the council to deal with the question on its merits. Those who protest against public control of the price of any commodity, denouncing the principle as socialistic and a menace to vested rights, should bear in mind that it is a condition and not a theory that confronts us.

A considerable portion of public sentiment in many places demands public regulation, actual or potential, of the charges of public service corporations. The condition of this public sentiment is such that the issue lies between the actual exercise of this constitutional power of public regulation of rates at certain brief intervals and the reserved power to regulate at any time. I prefer to concede the reserved power to regulate at any time; because this means that the power will be exercise at less frequent intervals, if at all.

Of greater prominence in the public mind at present than the question of public control of rates is the question of taxation of public service corporations. There is a growing demand for their taxation on the basis of actual value as shown by the market value of their stocks and bonds. I would assent to this demand if it were extended to include all other forms of property liable to taxation. I assent to the conclusion of economists who would have tax burdens distributed in proportion to ability to pay. This is merely the statement in another form of the principle of equality expressed in the Constitution of the United States, and in the organic laws of the several States. The Constitution of Iowa provides that the property of corporations for pecuniary profit shall be taxed the same as that of individuals and firms; and the statutes of Iowa provide for listing the property of certain public service corporations, including lighting companies, in such a manner that the entire property, tangible and intangible, shall be assessed. The intangible value is called franchise value, the legislatures having assumed that the value of the concern over and above the value of the physical property used in the operation of its business is a product of the franchise. This assumption might be disputed, but it is not worth while. The value, whatever its source, was really liable to taxation before the adoption of statutes providing special methods for assessing certain public service corporations Such liability, under the constitution, attaches to all values in the State, except those religious, benevolent and educational institutions especially exempted. Public service corporations offer no objections to the Constitution. They are ready to submit to a rule under which all values, no matter from what source they may arise, shall be subjected to the same rate of taxation, except that discrimination shall be made in favor of religious, benevolent and educational institutions, which it is desired to promote, and against unlawful enterprises, such as saloons and opium joints, which it may be desired to suppress, through the power of taxation, this being, as Justice Miller said, the power to destroy. The Supreme Court of Ohio recently ruled that a franchise tax is an excise tax, such as the State may impose on saloons, and that the State, which may tax the saloonkeeper on the value of the physical property used in the operation of his business and then impose an excise or license tax on the business, may subject the public service corporation to the same rule. Now in Iowa we protest that we are engaged in a legitimate business, that our public utilities minister to the comfort and convenience of the people, and that the community, the real estate owner especially, profits from our enterprise in extending our mains out to the suburbs to get new business. We object to being classified with the saloonkeepers as public enemies, who should be suppressed or destroyed, through the exercise of the power to tax. We object to discrimination against us; and we demand that we shall have the benefit of the rule applied in the assessment of legitimate enterprises generally.

Let the State provide methods of assessment whereby all values shall be listed, whether held by corporations, individuals or firms, and whether tangible or intangible, and we will cheerfully assent. But when the rule of the assessors is to list only the physical property used in the operation of the business, and when the State recognizes this custom, and provides by statute for exempting all intangible property of manufacturing and mercantile corporations, then we demand the same exemption; and to date our demand has been successful. The assessors, and the boards of equalization, have conceded it. The right of the Legislature to grant exemptions not specially authorized by the Constitution has not been tested, because the assessors have not attempted to enforce the statutes relating to the assessment of franchise holding corporations.

The reasons assigned for denying public service corporations the exemption granted other legitimate enterprises will not bear examination. It is said the value of the concern over and above the value of its physical property is the value of the franchise conferred by the public. But this is true only as it is true of all other values. Property means title. The public creates all property, and property would have no value if there were no public. The gas company, no more than the liveryman, has a special privilege. Its use of streets does not preclude their use by others on equal terms and, therefore, why deny it the exemption granted the liveryman? Not only has the gas company no special privilege, but the proposition is not to tax special privilege. Rather, the proposition is to tax special privilege if it is held by a public service corporation and exempt it if it is held by others, such as the owner of a trademark, or a patent right. Under the Iowa law the manufacturer's business is exempted, even though he depends for his bussness largely upon a trademark or a patent right, which is a special privilege, an exclusive right, a thing the gas company does not hold and cannot hold under the laws of Iowa. Moreover, whenever our laws, Federal or State, authorize the granting of special privileges, it is upon the theory that these will be awarded for the public's benefit. If this theory is sound there should be in our taxation laws no discrimination against the holders of special privileges; and if it is unsound we should not tax privileges, but should abolish them. If public service corpora-

tions are practicing oppression, don't license them; for to rely upon them as sources of revenue would be to reconcile the public to oppression that should be abolished.

Then there is the profit test. It is said the profits of public service corporations are extraordinary. As well say that the profits of grocers, or lumber merchants, or some other class of business men are extraordinary. Investigation would show the statement to be true of some public service corporations, some grocers and some lumbermen, and untrue of others. In every line some have succeeded and some have failed. Nor do those engaged in the gas business object to the proposition that we should tax profit. Their objection is to the proposition that we should tax profit if made in the gas business, and exempt it if made in other occupations no more legitimate and useful. They will accept the profit test, if impartially applied; but they object to discrimination. And if it were true that profits in the gas business are extraordinary, the public interest would dictate, not the taxation of the extraordinary profit but its destruction. The city council should not permit the gas company to rob the landlords' tenant on condition that it turn over a stated share of the plunder to the public treasury and thus lessen the landlords' tax burden. If the profits are unreasonable, justice to the tenant and to the consumers generally demands the reduction of rates. The consumer is wronged when high rates are maintained in order that the public revenues may be increased; and he is wronged again when a rate of taxation is imposed which compels the company to maintain rates which otherwise might be reduced without bringing the dividends below a reasonable basis. If gas companies as a class are making extraordinary profits, the fair conclusion is that discretion should be withdrawn, not from the boards that adjust assessments, but from the boards which fix rates running through the life of the charter. If the company's charges are reasonable it should not be made the victim of discrimination, and if its charges are excessive, the remedy lies in altering, not its assessment but its rates.

The Analytical Valuation of Gas Coals.[1]

[A paper read by G. P. Lishman, B.Sc., F.I.C., before the Institution of Mining Engineers, England. Reprinted by permission of the Council of the Institution.]

In the 17th and 18th centuries destructive distillation was the commonest process in use in chemical laboratories. Nearly everything was distilled from green glass, earthenware or iron retorts at various temperatures, a cooled tube or globe being used to condense the products; even vipers are stated to have been "analyzed" in this manner. As regards coal, the first recorded quantitative experiment was one by Stephen Hales, who, in 1726, obtained from 158 grains of pit coal 180 cubic inches of gas, equal to a yield of 10,340 cubic feet per ton, probably a very accurate result.

It was about the beginning of the 19th century that gas lighting began to be introduced into this country. In 1820 London had some 4,000 burners; and no doubt gas makers would, at an early stage, develop methods of distinguishing between good and bad coal. From the fact, however, that there is an almost total absence in scientific journals of papers on testing of gas coal, we may gather that the subject has been somewhat neglected. This has been largely due, no doubt, to the very considerable expense involved. The result has been that although coal testing plants are attached to most gas works now, they are usually of but limited use to the engineer, who still has to rely mainly on his working scale results.

When coals are tested under the usual conditions, the results, expressed in cubic feet per ton and candle power, come out most irregularly, and very considerable differences are found between one test and the next.

Nature of the Difficulties.—The cause of this trouble is to be found in the extremely complicated nature of the chemical reactions taking place in the retorts, and in the physical changes occurring in the condensers of the plant while coal is being distilled. Professor Mills has enumerated some 101 products resulting from the distillation of coal, and has given their boiling points: 0.1 per cent. (more or less) of some of them in the resulting gas will make 0.1 candle difference in the illuminating power. If the retort be a few degrees hotter than usual, the heavy hydrocarbons or illuminating constituents of the crude gas are broken down into simpler bodies, such as methane, ethane, etc., containing less carbon and therefore of less illuminating value. The carbon thus separated is deposited in the retorts as "retort carbon."

In the condensers, the changes taking place are more of a physical than a chemical nature, but are no less certain to cause fluctuations in the illuminating power, if the temperature be not kept constant. The function of the condensers is to remove from the gas all tarry matters which might cause trouble through stoppages in the mains. These same 101 products which have their boiling points have also their dew points, at which they condense from the gas, and if the condensers be a few degrees colder or the gas perhaps be traveling through them a little more slowly than usual, more benzol, say, will be condensed, and the illuminating power of the finished gas will be reduced; while under contrary conditions the reverse will be the case.

In fact, the main cause of the difficulties of coal testing in experimental plants may be summed up in the word "temperature;" and in this respect a small apparatus is much more rapidly affected by external conditions than a large one. In a works where there are many retorts, irregular gas coming from one quarter will be compensated for by that coming from another and "corrected" by this means, so that the result is a more or less uniform product from day to day.

Very slight differences of temperature in the condensers may make a considerable difference in the quality of the gas produced, and if we can overcome this it ends the difficulty from the point of view of the gas engineer, who has only himself to consider. For to him it does not matter whether the results from the testing plant are higher or lower, within limits, than those obtained in the works, so long as they are reliably comparative. This last is the desideratum which, so far, has been so difficult to obtain by any method that may reasonably be called a laboratory one.

The analytical chemist, however, is confronted with the further difficulty that from the same coal a better result will be obtained in one gas works than in another; this variation being caused both by differences of efficiency in the plant used and by the personal equation of the gas engineer. There is a point in steam coal analysis exactly analogous to this; the actual evaporative power of a steam coal varies according to the boiler used, but we overcome this by giving always the theoretical evaporative power which would be obtained were the coal perfectly burned and the heat entirely used for evaporation. The comparative figures obtained in this way, though higher than those got on the working scale, represent an absolute property of the coal, assume nothing, and are useful. But this cannot be done with gas coal, and, even if it could, would not be desirable. It is not advisable, because we cannot obtain on the testing scale as high results in winter as we do in summer, or in summer, here, as high results as would probably be got in summer in the south of France. For testing purposes the upper limit of the sperm value is exceedingly high, and long before it is reached the conditions under which we are working become quite abnormal. Gas results, it is now generally considered, must be reported in terms of what could be obtained from the coal, on a working scale, by a capable gas engineer using an efficient gas plant.

Attempt by Means of a Standard Apparatus.—The difficulties as above detailed fall naturally under two heads, namely: (1) Those connected with the temperature of the retorts and of the condensers; and (2) that due to the difference of results found in the various gas works. Keeping these in view various methods have been tried at Lambton for overcoming them, and for finding a means of testing gas coals on the laboratory scale. Some years ago it was thought that it might be possible to produce a standard apparatus, in which, by warming the condensers in cold weather and by other devices, the evil effects of winter days might be obviated. The condensers were water jacketed and kept always at 70° F., and sometimes sections of them were by-passed. This produced a slight improvement, but it was found that even when by-passing the whole of the condensers the mass action of the cold pipes and purifiers on the slowly passing gas caused much lower results to be obtained in winter than in summer. Moreover, this left the vagaries arising from variations in retort temperature quite out of the question. It had been hoped to avoid these variations by means of a mercury governor on the gas supply which heated the retort, but this expectation was not realized. It is easy to lay down ideal conditions which are always to obtain when tests are being made, but it has been found quite impossible to realize them in daily work.

These experiments, extending over 12 months, although failing in their primary object, or, rather, showing that it was unattainable, were of value as indicating two points, namely: (1) That in any apparatus designed for coal testing the amount of condensation must be capable of very considerable variation indeed; and (2) that in successive tests on the same coal the results are more constant when the condensation is rather heavy.

Apparatus Used.—In considering the design of a coal testing plant it is necessary to bear in mind that we cannot make our apparatus

1. The *Gas World.*

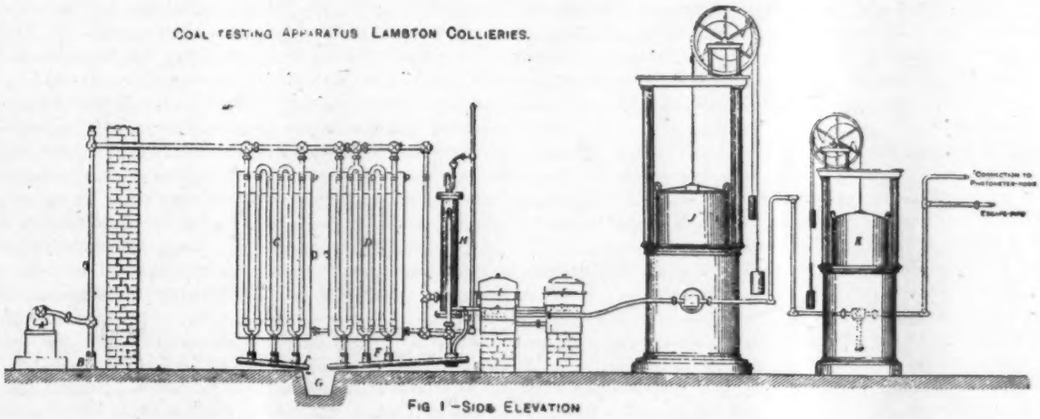

FIG 1 —SIDE ELEVATION

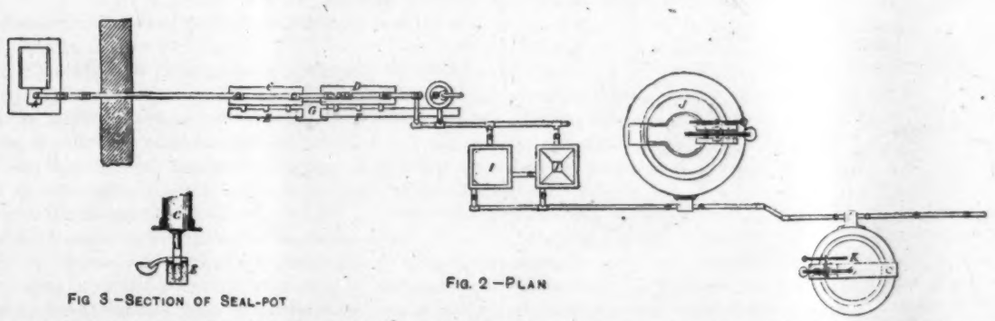

FIG 3 —SECTION OF SEAL-POT

FIG. 2 —PLAN

A retort heated by gas. The short bent pipe prevents excessive dripping of tar into the retort. Tar condensing in the ascension pipe is caught in the seal pot *B*. *C* and *D*, condensers, carrying cocks by means of which 1, 2, 3, 4, 5, or 6 tubes may be used at will, or the whole by-passed. The condensers are carried in water tanks, through which a constant stream of water may be kept running to secure an even temperature. This circulation is only necessary in hot weather, but the tanks are always kept full of water. The spout under the seal pots *E* and *F* carries tar and liquor into the tar pit *G*. *H*, scrubber, containing wet glass marbles, which can be by-passed at will. *I* and *I*, purifiers, one of which only is used at a time. *J* and *K*, gasholders.

model of a full sized gas works, for no two works are alike. At the same time, we must retain the same general outlines, consisting of retort, ascension pipe, condensers, preferably a scrubber, purifiers and gasholders. We must also use a sufficient quantity of coal to make at least 8 cubic feet of gas, as that is the least quantity with which the illuminating power can be satisfactorily taken.

By using a standard coal as described below, to correct for varied condensation, we do away with the necessity for adhering rigidly to one particular form of apparatus, but certain essentials cannot be neglected, particularly when work is to be done in all weathers. These may be stated as follows: (1) The condensers must be much larger, in comparison with the retort, than those used in gas works. They must be water-jacketed for cooling in summer, and so arranged that they may be by-passed in sections. (2) The purifying area must also be larger, in comparison with the retort, than is the case in gas works, so that in a considerable series of tests approximately the same conditions as to purification may obtain throughout. (3) Two gasholders, conveniently each of 15 cubic feet capacity, must be in use, so that tests may follow immediately one upon the other, and the temperature of the retort may be thus maintained the same during each experiment. (4) The whole arrangement must be placed indoors, and in summer the heat from the retort must be kept away from the rest of the plant. (5) A good photometer and spacious photometer room are also necessary. As regards this part of the subject, it will be enough to say that although the illuminating power of a gas is in this country is always stated as being of so many candles, the use of the candle as a standard of light in actual photometry has been widely discontinued, the Harcourt 10-candle pentane lamp or the Methven screen being used in its place.

The general arrangement of the plant at Lambton is shown in Figs 1, 2 and 3.

Routine Details of a Test.—One thousandth of a ton, or 2.24 pounds, of coal has been found a convenient and sufficient quantity to take for a test; about 10 cubic feet of gas is obtained, an amount which is ample for taking the illuminating power; but if the coal gives a poor yield a larger quantity may be taken. The coal is charged into the red hot retort in a sheet iron box, measuring 14 inches by 4½ inches by 2 inches, and the door, carrying its fireclay luting, is screwed tight. The tap at the entrance to the gasholder is immediately opened. In from 60 to 90 minutes the gas will have ceased to come off; the volume is then measured, and the retort discharged. The gas is next passed into the other holder, being thus properly mixed, and on to the photometer to be burnt there. The retort is at once ready for the succeeding charge, which is worked into the first holder as before, the illuminating power of the gas from the previous test being taken in the meantime.

Use of a Standard Coal Seam.—We have seen that it is not by any particular form of apparatus alone that gas coals can be satisfactorily valued; and as it is undesirable for statements as to their quality to vary on account of the season of the year in which the tests are made, it becomes evident that some correction must be applied to the results actually obtained before they can be accepted as true. "Corrections" in general are largely used in analytical chemistry, and, indeed, run all through practical science; for instance, the volume of a gas has always to be corrected for the temperature and pressure at which the observation is made. So there can be no objection to the method as such; it is only necessary that we should determine, on any particular day, the proper correction, and that it be maintained at a fairly small percentage of the final result.

In the case of coal, the correction is found by using a coal of known value. A standard coal has been used before, and is probably in use now in places; at any rate the idea is by no means novel, but its adoption is not at all general. Moreover, a ton of coals may be useful as a standard for a series of tests extending over one or two months, but the coal itself will begin to change after this time, and for continuous work no standard except a standard seam can be of any value.

At the Lambton collieries there is a seam which, within a certain area, is very fairly constant in quality, and the sperm value[1] of this coal is fixed at a figure obtainable from it at any of the best gas works. It is stored in small stocks at a time at the laboratories, so as to be always fresh. Anyone near a coal mine can with some little difficulty obtain a standard coal, but it is necessary to know the coal well and to exercise care in its selection.

1. The Gas Referees' standard candle burns 130 grains, or 3-175 pound of sperm per hour. Gas is burnt at the rate of 5 cubic feet per hour when being tested, so that the number of feet made per ton must be divided by 5 to reduce them to their equivalent in lighting units; and this number multiplied by the candle power, and the product by 3-175 (pound of sperm burnt per candle per hour) gives the illuminating value of the coal per ton in pounds of sperm, which is shortly called the "sperm value." Practically, the sperm value equals the yield of gas in cubic feet per ton multiplied by the illuminating power in standard candles and by 0.00643.

In testing an unknown coal, two blank charges are first worked through the apparatus, and the volume of gas obtained in these may be noted, but this gas is burnt away at the photometer without being tested. These preliminary charges are merely made so as to secure that the pipes, purifiers, etc., of the apparatus shall be full of ordinary "end gas" or "last runnings."

Three consecutive tests are then made: (1) Coal to be tested, (2) standard coal, and (3) coal to be tested, the yield being noted and the illuminating power taken in each case; and from these we calculate the sperm value Working in this manner we find out every day what a coal of known quality is doing, and the unknown is corrected proportionately. On a frosty day, for example, when condensation is unavoidably severe, condensers are short circuited, but still the sperm values come out as low as perhaps 490 or 500 pounds per ton from good coal, the standard being also affected in the same manner. This coal, which in August would give a sperm value of 600 pounds per ton, will only give 520 pounds. The value which can be got out of it in a first-class works is, say, 580 pounds, therefore the value of the unknown coal is found by the proportion, as 520 : 580 : : 495 : to the corrected sperm value in pounds per ton.

It will now be seen that when it is said that a coal has given in a testing plant results equal to "10,000 cubic feet of 16-candle power gas," that is, a sperm value of 548 pounds per ton, the statement as it stands is flexible, and that these 548 pounds, while actually obtained and possibly regularly obtained, may really require to be corrected down to 500 pounds before arriving at a figure which could be got from the coal at any gas works in the country.

But as a rule we have had, at Lambton, little success in correcting down, and we find that somewhat heavy condensation (which, of course, reduces the illuminating power) has a considerable steadying effect on the gas and on the result, which may then by means of the standard be corrected up to its true value. The most satisfactory tests are those in which the standard coal is given a sperm value from 20 to 40 pounds below its fixed figure, and as far as can be done the condensers are manipulated so as to secure this result.

Advantages.—(1) It will be seen that the practice of this method considerably minimizes the difficulties due to variable condensation. By the use of water-jacketing there is little difficulty in maintaining the condensers at a constant temperature throughout one day, and one day is all that is necessary, as the correction can be found on another day. (2) It is less difficult to keep the retort temperature constant for one day than to maintain it at the same temperature on different days. (3) The analyst's difficulty, caused by the variety of results obtained from the same coal in different gas works, is largely overcome, because the standard coal is fixed at a sperm value which can be obtained from it at our best gas works, and all corrected results are statements of what can be obtained from the coal at such works. (4) The method permits of the alteration of the form of the apparatus, from time to time, as improvements may be suggested, for alterations affect only the uncorrected results.

Conclusion.—By means of proper condensation, the use of a coal seam as a standard, and careful attention to retort heat, gas coals can be somewhat finely discriminated by a laboratory method; and the use of a standard coal is regarded as absolutely essential to success.

The writer's thanks are due to the Lambton Collieries, Limited, for having, during several years, supplied the expensive apparatus necessary for the various experiments which have been carried out, and to Mr. C. W. Martin for the constant interest which he has taken in the progress of the work during that time.

Temperature and the Output of Gas Fires: Is it Colder Before or After Christmas?

By (the late) Mr. E. W. T. Richmond.[1]

[There is a melancholy interest attaching to this article. A short time before the fatal accident to Mr. Richmond, he handed us a rough sketch of it, asking whether we should be prepared to publish it if it was completed. Unfortunately, Mr. Richmond has not been spared to put the finishing touches to the composition; but gathering his views from the notes and the portions he had already roughly drafted, we have endeavored to put before our readers what he himself intended to present to them. His idea was to have the article ready for publication about the beginning of October—the first month covered by his temperature records; and, as far as possible, we have endeavored to comply with his wishes.—Ed. J. G. L.]

In the course of the past few months, there have now and again been passing references in the *Journal* to the effect of temperature upon gas consumption; and they have called to mind an inquiry that I made some few years since into this very question of temperature and its effect indirectly on gas consumption, but more directly on the sales of gas fires. I do not intend to obtrude upon my readers beyond the opening paragraphs the fact that I am a maker of those useful, comfort promoting adjuncts of a household; and I may be permitted the remark that no one could be more conscious than myself that any advantage which may arise from the discussion of this question of temperature from my point of view will only be shared by me as a unit in the gas fire industry. But as a unit I am deeply interested in the question; and as suppliers of the fuel used in these appurtenances of the home and the business establishment, gas managers, directorial and professional, have an equal interest. The greater the success of the one supplier, the greater the success of the other. The more fires there are sold, the greater is bound to be—no matter what the temperature in a given winter—the consumption of gas for heating in that winter. Therefore in anything that can be done by the gas fire makers or the gas suppliers to increase the output, the benefit must be mutual. To this end the present article is written.

Unrealized Expectations.—Now in the winter months, one, of course, expects that the demand for gas fires will be greater than in any other period of the year; and so it is. But, if we take the 6 months extending from October to March, it is found that, after a respectable start has been made, as the thermometer continues to fall, so does the demand for gas fires. In other words, a diagrammatic representation of the rises and falls of temperature and of the output of gas fires would show that, while the line for the latter would steadily ascend with the gradual drop of the line for the former during the first month or two of winter, afterwards, with the further descent of the temperature line, the gas fire line instead of continuing to ascend would show a break and rapid fall. In the case of most other necessaries to human comfort in the winter, with a snap of cold weather the greater is the demand; but, curiously enough, in the case of gas fires, there is an inversion of this almost general law—the colder weather which is experienced (as it is the intention of this article to prove) after Christmas than before has no effect in causing a boom in the demand for gas fires. Why this should be so presents a most interesting problem, but such a many sided one that I for one beg to be excused from fully discussing it. Whatever might be said to account for it would be to a large extent suppositional; and as this is a case in which assumption will not help us so much as fact, we will ignore it, and turn to the consideration of an ascertained condition of things which may be of service to the gas manager and to the gas fire vendor in bifurcating in a pronounced manner in the coldest months the gas fire and temperature lines in our hypothetical diagram, instead of permitting them to run collaterally as they now do in those coldest months.

Householders' Mistakes and Procrastination.—As a matter of gas fires, the phenomenon of which I have spoken in connection with their sales or demand forced itself upon me some few years since; and I then—at first more out of curiosity than anything else—began looking about for a *raison d'être.* I found that my experience was shared by many gas authorities, some of whom, let me say, are in a remarkably good position for placing gas fires, if consumers can only be induced to take them. While declining to discuss here the question in all its bearings, it may be said that the general conclusion I arrived at was that, among householders there is an impression that, with the turn of the Christmas season, the worst of the winter has been passed, and that any neglected provision for heating need not cause them any further uneasiness in the ensuing months. A greater mistake was never made. When the mistake is realized by the sudden fall of the thermometer, and the good housewife is abruptly surrounded by the tribulations which are inseparable from the coal fire—the work, grumbling, dust, soot, provision of necessaries, and other unpleasant evils which derange the composure of many members of the house—then it is considered too late to effect the installation of gas fires, which friends have found so useful, cleanly, and labor saving, and always ready to defy any sudden fall of temperature. A good resolve is made that before winter sets in again, gas fires shall be installed. The summer comes; and the resolution gets rapidly pushed back into the utmost recesses of the memory. Winter enters, but the drop in temperature is so gradual that the resolution remains dormant. Christmas passes, and then—to the distress of the housewife—the experiences of the previous year return. So the history of the gas fire question in the household repeats itself year after year in most cases. Little is done—the gas supplied for heating does not progress at the percentage rate that it ought to do, and the makers of gas fires do not reap that winter harvest that their goods should yield.

Gas Suppliers and Negligent Consumers.—Now it is in connection

1. *Journal of Gas Lighting.*

with this question of lower temperatures after Christmas than before that, if I may be permitted to make the suggestion, gas suppliers might do something to rouse negligent consumers into the making of provision, by showing them, through recorded and authentic statistics, that it is a mistaken view to suppose that, with the passing of Christmas, the worst of the winter has been seen and felt. Beyond enabling gas managers to do this, it would ill become me to suggest that the figures I have obtained will teach them anything. I know full well that for many years past it has been recognized by the gas profession that a low temperature has more effect in bringing about big gas outputs than any other climatic variations from agreeable conditions. A sudden accession in demand tells them (more often than not) as plainly as Fahrenheit or their own personal feelings could do of a drop in temperature; and therefore they must know, as well as my figures can inform them, of the facts that I now suggest they should bring prominently before householders in their particular districts. The diagrams which the late Mr. Frank Livesey gave to us through the columns of the *Journal* nearly sixteen years ago established the remarkable relationship between temperature and gas consumption; and those diagrams and the accompanying article I studied with considerable interest at the time of my inquiry a few years since.

Consumers Fly to a Handy but Questionable Means of Heating.—But there is another point to which, so far as I have been able to trace, attention has not been called before, in connection with those diagrams; and it is this that, though the consumption of gas is shown to have oscillated with a near approach to exactitude with the temperature—that is to say, as the thermometric indications descended, the consumption ascended, and *vice versâ*—there were, comparatively speaking, few gas fires in those days to account for the rise in consumption on the fall of temperature, and the drop in consumption on the rise of temperature. Accepting this as true, and I do not think that anyone will gainsay it, then it proves a preference on the part of the public for an easy and handy method of obtaining warmth; and, generally speaking, the handiest thing that they had at the time Mr. Frank Livesey's diagrams were published was the old fashioned flat flame gas burner which they used for lighting. They wanted additional heat, but they did not want the trouble of lighting extra fires. This assumption I based—let it be confessed—on the foundation of personal experience; and my own experience in this respect, I fancy, is that of most other people. But if gas managers will recognize more this natural inclination on the part of their consumers, it might be an incentive to greater industry in endeavoring to place additional gas fires; the simple fact (as I think it may be called rather than an assumption) offers, indeed, a line of fire that could, I am sure, be used with telling effect.

Argumentum ad Judicium.—Agreeing, then, that consumers fly to gas burners for obtaining extra heat, what a splendid field of argument it opens up to the gas manager in exploiting the gas fire. For instance, there are the facts that, as effective agents for the purpose of heating an apartment to a degree of enjoyment and comfort for the occupants, gas burners are wrongly placed; in the case of flat flames, they are for the purpose wasteful in the extreme, and are nearly equally so in the case of incandescent gas burners. The best position for lighting is the worst possible for obtaining a comfortable warmth for the body, and so there can be no two questions as to the course adopted by the gas consumer being the least advantageous. These are only simple arguments—and many others will occur to the gas manager—which may be used, and they arise out of the propensity of the gas consumer to jump at the best available means (albeit improper ones) to obtain warmth when the temperature falls to a provocative degree.

The Coldest Part of Winter.—This brings me back to the original purpose of this article, which is to show first the period of the year when it is coldest, and when one would expect a "boom" in gas fires; secondly, to give gas suppliers data which can be used to show consumers their mistake in supposing that the coldest of the winter has passed with the end of the year; and, thirdly, to convince them that there is just as much, and even more, reason why they should have gas fires fixed in January and February as in October, November, or December. Consumers may meet the argument by calling to mind extremes of severe cold before the great annual festival, and of mild weather after. These extremes naturally impress themselves on the mind, and create the uncertainty which it is difficult to remove. But figures which have been obtained direct from, and bear the authority of, the Meteorological Office, cannot safely be disputed by the most obstinate of consumers.

Thirty Winters' Temperature Observations.—When formerly inquiring into the peculiar conditions which attracted my notice some few years since—that almost in the beginning of the coldest three months of the year the ebb tide of the gas fire trade had already set in—I obtained from the Meteorological Office, in order to be possessed of definite information on the subject, the recorded observations for the winter months of various well known towns in England, Scotland, and Ireland, extending over 25 consecutive years from 1871 to 1895. These proved my point; but, my interest being revived in the matter, I have secured from the same source, for the purposes of this article, the maximum, minimum, and mean observations extending over the thirty years to 1900.

Instructive Comparisons.—The table lends itself to many instructive comparisons. Month with month can be compared, town with town, and area with area; and the gas manager who is interested in doing this will find means of usefully applying the lessons that are to be learnt from the analysis. It would, I am afraid, detract from the general interest that this article it is hoped will arouse, if it is burned with too many comparisons; and therefore I will content myself by drawing attention to the actual differences of temperatures between the closing three months of the year and the first three, in order to give an answer to the question forming the sub title of this article. It will be remembered that the figures are averages extending over thirty years, which absolves them from depreciatory criticism on the score of casual extremes in the oscillation of temperature records. The variations in tem-

Mean Values of the Daily Maximum and Minimum Temperatures, and of the Maximum and Minimum combined, for the Months of October, November, December, January, February, and March, derived from Observations extending over Thirty Years, 1871 to 1900, as supplied by the Meteorological Office.

Station.	October.			November.			December.			January.			February.			March.		
	Max. Deg.	Min. Deg.	Mean. Deg.	Max. Deg.	Min. Deg.	Mean. Deg.	Max. Deg.	Min. Deg.	Mean. Deg.	Max. Deg.	Min. Deg.	Mean. Deg.	Max. Deg.	Min. Deg	Mean. Deg.	Max. Deg.	Min. Deg.	Mean. Deg.
Scotland—																		
Aberdeen	52.5	41.2	46.9	46.6	37.1	41.9	42.4	33.3	37.9	42.1	33.0	37.6	45.2	33.2	38.2	45.8	34.3	40.1
Glasgow	51.8	41.6	46.7	46.4	37.9	42.2	42.7	34.5	38.6	42.3	34.2	38.3	43.1	34.8	39.0	45.5	35.2	40.4
Leith	54.6	41.5	48.0	48.5	37.5	43.0	44.5	34.1	39.3	44.1	33.6	38.9	42.6	33.9	39.8	48.0	34.5	41.3
England—																		
Durham	53.6	40.4	47.0	47.0	36.3	41.7	42.2	32.5	37.4	41.6	31.7	36.7	43.5	32.4	38.0	47.0	33.2	40.1
York	54.6	41.1	47.9	48.0	37.1	42.6	43.0	32.9	37.9	42.6	32.3	37.5	44.6	33.2	38.9	48.4	33.8	41.1
Liverpool	53 8	44.5	49.2	48.3	40.0	44.1	44.2	36.1	40.2	43.3	35.0	39.2	44.5	35.7	40.1	47.1	36.8	42.0
Oxford	55.6	42.1	48.9	48.8	37.9	43.4	43.7	34.0	38.8	42.9	33.3	38.1	45.2	34.3	39.8	49.3	34.6	42.0
Yarmouth	54.5	44.6	49.6	48.0	39.5	43.8	42.7	34.2	38.4	41.3	33.3	37.3	42.5	34.1	38.3	45.3	35.3	40.3
England, South—																		
London	56.8	42.9	49.9	49.8	38.5	44.2	44.7	34.4	39.6	43.8	33.6	38.7	45.8	34.7	40.3	50.1	35.3	42.7
Dover	56.6	46.2	51.4	50.1	41.1	45.6	45.2	36.3	40.8	43.3	35.1	39.2	44.5	35.6	40.1	46.7	36.6	41.7
Southampton	57.6	43.9	50.8	50.5	39.6	45.1	45.5	35.7	40.6	44.3	34.9	39.6	46.5	35.9	41.2	50.4	36.4	43.4
Plymouth	56.9	45.5	51.2	51.7	41.6	46.7	47.9	38.2	43.1	46.5	37.2	41.9	47.7	37.9	42.8	50.0	38.1	44.1
Falmouth	55.9	47.7	51.8	51.4	44.1	47.8	48.2	41.1	44.7	46.8	39 9	43.4	47.4	40.4	43.9	48.6	40.1	44.4
Jersey	58.6	48.9	53.8	52.6	44.4	48.5	48.1	40.1	44.1	46.1	38.4	42.3	47.3	39.0	43.2	49.8	40.0	44.9
Ireland—																		
Armagh	53.1	41.3	47.2	47.7	37.6	42.7	43.5	34.2	38.9	43.3	34.1	38.7	45.1	35.0	40.1	47.6	35.1	41.4
Dublin	54.5	44.2	49.4	49.9	40.9	45.4	46.1	37.3	41.7	45.8	37.3	41.6	47.0	37.9	42.5	49.0	38.2	43.6
Parsonstown	54.7	40.5	47.6	49.4	37.2	43.3	45.5	34.0	39.8	45.2	33.8	39.5	46.9	35.0	41.0	49.8	34.8	42.3
Valencia	56.4	46.3	51.4	52.4	43.0	47.7	50.1	40.6	45.4	49.1	39.9	44.5	49.5	40.4	45.0	50.9	40.1	45.5

perature from month to month are obvious at a glance, and so space need not be taken up in referring to them.

Aberdeen.—Dealing with our table in the order in which the records are returned from the Meteorological Office, I have first to take Bonnie Scotland, beginning with grey Aberdeen. The method I am going to adopt to prove the point as to the second half of the winter being colder than the first, is to take the maxima for the first three months, add them together and divide by three to get the average. Then deal with the maxima for the second three months in similar manner, and subtracting the lower product from the higher, the difference in the maximum average temperatures for the two periods will be obtained. Following this, the minimum and mean temperatures will be treated in the same manner. Thus, for example, in the case of Aberdeen we take the maxima for October, November, and December—

$$52.5° + 46.6° + 42.4° = 141.5° \div 3 = 47.1°, \text{ the average.}$$

The maxima for January, February, and March, are—

$$42.1° + 43.2° + 45.8° = 131.1° \div 3 = 43.7°, \text{ the average.}$$

Now, subtracting 43.7° from 47.1° shows us that the maximum temperature over the thirty years was 3.4° lower after Christmas than before in the case of Aberdeen. Treating the minimum temperatures in the same way, we again find that the second period, on the average, was colder than the first by 3.7°, and that the mean temperature was 3.6° less. Surely when such facts as these are laid before the Aberdonians, they will cease to shiver after Christmas because they have not before the festive day laid on the gas fires "that cheer, but do not suffocate." In passing, it should be explained that my differences in the mean temperatures are calculated from the figures in the table, and not from the averages obtained by me in dealing with the maximum and minimum temperatures.

Glasgow.—From Aberdeen we flit to Scotland's commercial capital; and there we get, from our calculations of the average temperatures of the past 30 years, a peculiar result. Whether we take the maximum, minimum or mean temperatures, it is found, that in all cases, the difference between, on the one hand, October, November, and December, and on the other, January, February, and March, is 3.3° That is to say, after Christmas, whichever group of figures we take—the maxima, the minima, or the means—the temperature is 3.3° lower after Christmas than before.

Leith.—From one of Scotland's ports, we now proceed to another—Leith—which will also serve for its beautiful neighbor, Edinburgh. Here we find that, in the 30 years, the maximum temperatures show that it is colder by an average of 3.3° in the 3 months after Christmas than before, the minimum by 3.7°, and the mean by 3.4°. Our friends of the Edinburgh and Leith Gas Commissioners will, therefore, do well to prevail upon their customers to hire gas stoves with the New Year "for present comfort and for future good."

Durham.—Our quest for average temperatures next brings us to Durham, where at the pit's mouth gas for heating must depend more upon its handiness and cleanliness than upon its cheapness. It will even then score a victory. Thirty years' figures disclose to us that the maximum temperatures there are, on the average, 3.6° lower in the first 3 months of the year than the last 3, that the minimum temperatures are 4° lower, and that the means are 3.8° lower.

York.—Alighting next at the old northern capital of York, we ascertain that their experience has been practically the same as that of Durham; the average maximum temperature being 3.3° lower in the quarter after Christmas than before, the minimum temperatures 3.9° lower, and the means 3.7° lower.

Liverpool.—Crossing over to Liverpool, a rather worse state of affairs is found in proof of the point that should be impressed on consumers. There the average maximum temperatures after Christmas are 3.8° below those of the 3 preceding months, the minimum 4.4°, and the mean 4.1°. So that it is the old, old story here that "as the winter days grow longer, the cold grows stronger." Some time since Mr. S. F. Millard, of the Liverpool Gasfittings Company, supplied me with a few interesting figures relative to their trade in gas fires and heating stoves before and after Christmas; and they showed that of every 100 stoves sold 72 were disposed of before Christmas, and only 28 afterwards, or practically three-fourths of the trade was done in the warmest months of the winter, and only one-fourth during the coldest. This, I have not the slightest doubt, arises from the popular idea that, having once "got over Christmas" without a gas fire, householders can do without until another winter. The records of Plymouth and Dublin are very similar.

Oxford.—We now descend to Oxford, only to find this seat of learning teaches us the same lesson—that the average of the maximum records shows that it is 3.5° colder in the first 3 months of the year than in the preceding 3, that the minimum temperatures are 4° lower, and that the means are 3.8° lower.

Yarmouth.—To make our tour complete, we return to the eastern coast and visit Yarmouth, which shows, next to Dover, the greatest variation of temperature between the months after Christmas and those before, of any of the cities or towns in which the 30 years' observations were taken. The maximum temperatures are lower by 5.4°, the minimum by 5.2°, and the mean by 5.3. When these facts are brought home to East Anglians, we may expect to see a revival of the heating stove trade in the district at the beginning of the year.

London.—Our great metropolis has now to receive attention. Nowhere, perhaps, is the labor saving gas fire so essential as in London; and the figures adduced here should be useful in "booming" gas fires during the coldest months of the year. The temperatures of our 30 winters reveal to us that the average of the maximum readings is 3.9° lower after New Year's Day than before, the minimum observations 4.1° lower, and the mean 4° lower. A word in season should produce an abundant harvest for our Metropolitan Gas Companies.

Dover.—Travelling to the southeast, it is shown, as already hinted in dealing with Yarmouth, that Dover "takes the palm" for the widest variation of temperature in the periods of comparison. There the averages of the maximum temperatures in the first 3 months of the year are 5.8° lower than in the preceding 3, the minimum temperatures 5.5°, and the mean 5.6°.

Southampton, Plymouth and Falmouth.—To complete our inquiries in England, we will take a rapid trip along the south coast, with the result that at Southampton, Plymouth and Falmouth we get further confirmation, and almost corresponding results, respecting the average lower temperature in the second as compared with the first half of the 6 months—the differences (for the 3 towns) being in the maximum temperatures 4.2°, 4.1° and 4.2°; in the minimum temperatures 4°, 4°, 4.2°; and in the mean temperatures, 4.1°, 4.1° and 4.2°. I may remark that, of my own knowledge, at Plymouth the gas fire trade, if not done before Christmas, is undone—a state of things that I hope my figures will help to rectify.

Jersey.—Before leaving the south, we will just make an excursion over to Jersey to ascertain the condition of the temperatures there. It will perhaps be a matter of surprise to many to find that in at least one respect Jersey and Yarmouth can boast of having something in common—the variation in their temperatures between the first 3 months over the 30 years and the last 3 months having a remarkable correspondence. The averages of the maximum temperatures show that it is 5.4° colder after Christmas than before, of the minimum temperatures 5.3°, and of the mean temperatures 5.4°. Our friends across the channel may like to interest their consumers with this fact; and I hope it will be with a beneficial result.

The Emerald Isle.—To complete our review of the 30 years, we must pay a rapid visit to the observatories of Ireland; and it is seen that, while there are some large fluctuations in temperature in individual months, there is ground for congratulating our friends on the fact that, taking the averages of the first half of the heating months and the second half, they show a nearer concordance than any other part of the British Isles. They still tell the same tale, however—that it is colder after Christmas than before. Taking Armagh first, the average of the maximum temperatures is lower in the latter half of the 6 months by 2.8°, the minimum temperatures by 3°, and the mean temperatures by 2.9°. The Dublin differences are very similar—viz., 2.9°, 3°, and 3°. The same with Parsonstown: 2.5°, 2.7° and 2.6; but the Isle of Valencia is slightly worse, with differences of 3.1°, 3.2° and 3.1°. Although, as the figures prove, it is colder after Christmas than before, statistics which I have by me as to the fires fixed in Dublin disclose a remarkable falling off in the output of gas fires in the colder months of the winter compared with the warmer ones.

In Conclusion.—I think that the statistical facts set forth here will prove thoroughly the point that it is colder in the second part of the winter months than in the first. Among my collection of information on the subject are several interesting cuttings from newspapers, which remind me of the terribly severe weather which we experienced last February. But it is not my desire to make a point of any exceptional year—preferring to base my argument on the authentic figures of a long series of years, which neutralize any extraordinary thermometric readings caused by unusual accessions or diminutions of temperature. I quite recognize that objection may be taken to October being included in calculating the averages. This is not a point of weakness, as then the heating season usually commences in many parts of the country. But if we eliminate October, the table still proves a lower temperature and a longer spell of cold weather after December 31 than before. For

my own satisfaction, I have dealt, in the same manner as explained, with the figures for November and December, comparing them with January and February; and even then we get an average lower temperature for the latter months of from 2° to 3°. And the low temperatures continue over the third month after Christmas. Yet the demand for gas fires drops off after the festive day in a most extraordinary manner! Further, I also recognize that the argument may be advanced against me that the fact that there is a greater demand for gas fires in the 3 months preceding Christmas than in the succeeding 3 months is a clear indication of the prevision of householders. To the extent to which business is done, I agree. But my experience of the gas stove trade has not convinced me that foresight is a special attribute of gas consumers; and, therefore, I ask: Should not the accession of colder weather after Christmas have the effect of at least maintaining the ratio of sales, and not permit them to fall to an insignificant point? Besides which, I am not prepared to admit that the gas fire trade at any part of the winter season is at the level which one should expect it to be at with such average minimum temperatures as those shown in the table. The figures—and their proof of colder weather in the beginning of the year—offer arguments for use in stirring up this branch of the winter's business to the advantage of both gas suppliers and gas fire makers. It can hardly be supposed that the facts as given here are known to many gas consumers—to the best of my knowledge they have never before been published or dealt with in this particular manner. Then advertise them, or make use of them in any other suitable way, to accelerate the placing of gas heating stoves. The colder weather of January and February should not freeze effort, but, on the contrary, should incite it and stimulate demand. Gas suppliers should drum it into the ears of gas consumers, or keep it strikingly before their eyes, that it's never too late to fix gas fires.

The Installation of Electrical Machinery in the Tropics.

By Mr. Chas. H. Hines, in *Elec. World.*

With the rapid increase of the work of installing lighting and power plants in countries lying within the tropics, especially during the last 5 years, and the recent extension by the United States of its sway into such climes, the writer of this article, having been one of the pioneers in this particular line at a time when the field was new and untried, and remembering his own troubles and the lack of any previous knowledge to draw upon, feels that the relation of a few of the peculiar "bugs" that may be expected, may prove interesting and profitable to those who may be called upon to undertake this class of work.

In the early days of this work, it was the usual thing for the South American merchant when he had decided to install an electrical plant, to place the order with his agents in the States in very much the same manner as he would order a consignment of groceries or other goods; and in many cases the agent, only considering how large a commission could be exacted and the cheapness with which he could purchase, bought the plant without any regard to the class or fitness of the material. Finally, at the last moment, he would engage an engineer to go with the outfit, to erect it, and usually his selection of the man was on a par with his selection of the material.

In most cases the engineer arrived at his destination only to find that the machinery ordered was either not adapted to the requirements of the case or wofully lacking in many essential things. This meant many weeks of delay and vexation, and this coupled with his lack of knowledge of the country and customs, rendered his employers only too prone to place the blame upon his shoulders, forgetting the fact that he had not been consulted in the least regarding what had been ordered, and that he would have been entirely unfamiliar with the peculiar necessities involved, even had he been so consulted. At the present day, however, the field has broadened, and in the case of many large power and lighting enterprises the services of skilled consulting engineers are called upon to direct the preliminary work; but it will be found in most of these cases that these enterprises are backed or controlled by American capital, and that the native of the country when left to his own devices still persists in putting the cart before the horse—that is, buying his plant first, and hiring his engineer afterward.

The first and most important thing to be considered in taking up this class of work is a thorough knowledge of the foreign language; for without that the engineer, no matter how great his ability, will find himself sadly handicapped. Even though he may procure the services of an interpreter, he will soon find that he cannot depend upon him to interpret faithfully, and will be led into serious errors owing to mal-interpretation, both as to his work and to differences with his employers. In many cases this occurs through maliciousness due to jealousy or other causes, and is always a constant source of annoyance. I well remember my own first experience, when my knowledge of Spanish was nil, and I used to wander around with a piece of paper on which I had written down the Spanish and English meaning of different tools, etc., forgetting that the pronunciation of the words was most essential. On getting screw-drivers for screws, wrenches for bolts and like mistakes, I would be gravely assured by the dusky workers in my employ that my Spanish was "muy malo"—very bad—and I have no reason to doubt them, judging from the results obtained. Spanish is an easy language to acquire, and should be learned in advance, as the process of learning on the ground is slow, vexatious and costly.

Before sailing, the engineer should always go carefully over the list of materials sent, checking off all articles, and being sure that he has everything required to the very nails and screws, for should anything be omitted it may mean weeks of delay, and in any case he will pay dearly for what he has to purchase on the ground, even if obtainable. I well remember on one installation which was to have iron poles made of three sizes of pipe connected together by reducers, and, through error, sufficient reducers were sent for but half the number of poles, being fortunate enough to be able to find them in the town I was under the necessity of paying $4.50 apiece for an article worth about 30 cents in the States.

Arriving at his destination, the engineer will find that his machinery is generally handled in any old way. He must personally supervise the unloading of the same if he wishes to preserve it unbroken, and his ingenuity will be called upon from the start if the plant is located at any distance from the port of disembarkation; as in most instances mules or oxen are the sole means of transportation, and the roads are invariably vile, even in the dry season, and generally impassable during the wet one. I have been 3 months conveying the heavy castings of generators over a distance of 40 miles.

A knowledge of the conditions to be met with in advance is here of great service in regulating the weights of the packages to be handled. It is here also that the first lesson regarding himself must be learned by the engineer, and that is the care of his health. If the place where he is located is unhealthy, and most tropical towns are more or less so, too much care cannot be taken until well acclimated. He should wear a flannel band around the stomach, drink sparingly of water, and that filtered or boiled, avoid much fruit, and always sleep a story or two above the ground, the higher the better, and also keep indoors at night; and above all things, observe the strictest temperance. Right here, let me explode a fallacy that has caused the death of more than one bright man in these countries, and that is the saying that will be repeated by natives and even his own countrymen located there, that "a little liquor is absolutely required in the drinking water," or "drink to keep out the fever germs." This is not only untrue, but the surest way to bring about what he wishes to avoid. I have tried both methods; in one case succumbing to fever within two weeks, and in the other I passed six months in one of the deadliest ports of South America untouched by any disease by practicing strict abstinence.

We will now suppose the engineer on the ground where the plant is to be erected, and ready to begin operations. Now begins the test of his fitness for this class of work, as he finds that he must be in turn surveyor, mason, blacksmith, machinist, boilermaker, engineman, lineman and a few other things, besides being an electrical engineer. The first and greatest trouble to be encountered is labor, and this varies greatly in different countries. I have found the brightest and best men in Central and South America, many of them capable of being taught anything, and generally willing and sober; while the poorest class of labor I have met with has been in Cuba and the West Indies. But wherever found, save in the large cities, they are in most cases ignorant of even the appearance of electrical machinery, and must be taught from the beginning even how to handle tools; and tact and patience of the highest order are required. The motto of the Latin-American workman is, "never do anything to-day that can be possibly put off until to-morrow," and the employer must go slowly in combating this idea lest he incur the hatred of his men—this meaning in some cases his sudden decease. He will learn the word "manana" (to-morrow) until he hates the sound of it, as, no matter what he wants done or how urgent it may be, it will be done "manana." However, patience, and above all a perfect command of temper, will overcome all obstacles in time, and he will find his troubles lessening as his pupils grow more apt. Let him always direct and not try to do it all himself. The saying is in these countries, "If you see one man working and the rest sitting down, the man working is boss; and if you see one man sitting down and the rest working, the man sitting down is boss;" and it is most true in every respect.

In handling and erecting the heavy pieces, the engineer had better personally see every hitch and tie made on all work, as otherwise disaster is sure to follow. This also applies to line construction, until his men become more or less familiar with the work; they will generally spurn "climbers" and work with bare feet and a rope around the waist, but will get there just the same. The matter of insulation must be carefully looked after, owing to the heavy rains and dampness of these climates. All work in this line should be done in the best possible manner, as on this will depend to a great extent the success or failure of the plant, and the higher the voltage carried, the greater the safeguards to be taken. In the matter of poles, galvanized iron is the most reliable, as insects and dampness soon play havoc with the best of wood, and the expense of labor attached to replacing them more than balances the extra cost of the iron ones.

In the matter of stringing wires, the fact of the great expansion during the intense heat of the day and contraction in the almost always cool nights, must be taken into consideration, or trouble will ensue from the start; and above all, the matter of protection from the heavy thunder showers of the tropics must be given the most careful study. The very best arrester obtainable should be employed. and all parts of apparatus liable to injury carried in duplicate, especially armatures, unless the engineer is capable of rewinding the same. Right here let me say that nine-tenths of good engineers are unfamiliar with the practical part of armature and field winding, no matter how well they may be grounded in the theory and design, yet such knowledge is invaluable in this class of work.

If the prime movers of the plants are wheels or turbines, as in all cases where possible they should be, owing to the high cost of fuel—coal costing in many parts as high as $20 per ton, gold—another factor of trouble must be considered in planning the hydraulic part of the station, and that is the rapid rise that takes place in the streams after a heavy rainfall. I have seen a river from which I derived my power rise 15 feet in as many minutes. Great care must be taken to provide for this, more especially if the work is installed during the dry season, as otherwise the labor of months may be destroyed in a brief hour. In all cases these streams are filled with floating vegetation and drift, causing endless trouble in clogging turbines, breaking gate valves, etc., if not most carefully provided for.

We will now suppose the station completed and everything ready for the start. Let it not be thought that the troubles of the engineer are over; for, on the contrary they have but begun. He will now appoint his assistants from among the best of the men who have aided him in the construction, and it is now he will encounter fresh troubles. The egotism of the average native is prodigious, and he will at once, on attaining a little knowledge, assume much more, and, if not closely watched, will cause disaster by attempting to do more than he is capable of doing. He will handle the most intricate machiney with a superb disregard of consequences that will make the beholder shudder, and is only too ready to do, not what he is told, but also what he is told not to do. When he has worked a few months, he considers himself a full fledged "electricista," and resents any further instruction. I well remember an instance which illustrates this fact, in a plant which I had erected, and in which on occasions we were obliged to run our alternators in synchronism. I had a rather bright native acting as station man, and I cautioned him particularly never to attempt to throw his machines together without first calling me, as, owing to several causes, the synchronizing of the machines was a difficult matter. My back was hardly turned, however, when he *did* throw them in without synchronizing, with the result of his leaving by the window route, leaving me with a two weeks' shut down on my hands. In this connection there is a story which I can well believe of a Mexican who was left in charge of the boiler of his plant, and the superintendent happening in later saw to his horror that the handle of the steam gauge was crowded over against the pin at the far side, while the engineer was still feeding the roaring furnace for all he was worth. As soon as the superintendent could haul the fire and get his breath, he inquired the reason for such proceedings, and the answer was, "Well, what are the figures there for if the steam is not to go to that point?"

There is another side to this matter that has a more or less serious bearing to the seller and manufacturer of the plant, and that is that when the contract of the engineer who erects the plant expires, in nine cases out of ten his employers will either refuse to renew the same or insist on his accepting far less salary. In most instances they have a touch of the same egotism, and think that one of their own countrymen is entirely capable of taking charge at far less money, and the consequence of this idea is, in many cases, the total ruin of the plant, with the fault laid at the door of the makers of the machinery, when it is the fault of the unskilled man who was placed in charge. I have seen in a Mexican city, a fine new plant, with the most approved apparatus, engines, etc., and after a year's run under native management, I have seen the same plant again, its fine machinery rusted and covered with filth and oil, the belting saturated with resin and the whole place a wreck, while the line work had fallen into a condition that not only endangered the plant but the lives of the citizens.

After starting up and getting the plant to running in more or less smooth shape, other troubles may arise, caused by the ignorance or the superstitions of the natives. Lamps are stoned and broken, lines cut or poles uprooted, and for these troubles drastic remedies are needed. The severe punishment of any offender caught will generally have a salutary effect on others. This annoyance is not always confined to the ignorant, however, as in the case of one plant which I erected and where from the start I was bothered by the continual breakage of lamps. I found on doing a little quiet detective work that the chief offender was no other than the cashier of the bank there, who found it "great fun" on his nocturnal rambles to destroy property. A fine of $200, coupled with the threat of a long term of imprisonment for a repetition of the offense, convinced him that this class of fun was an expensive luxury.

In conclusion, I may say that these countries have but just awakened to the necessity of electrical development, and in the near future will be the chief fields of electrical enterprise as they become more developed and opened up by the energetic Anglo-Saxon. At the present time any young engineer who understands his profession and their language, and can interest capital, can find valuable franchises in these countries for almost the asking. The chief trouble that arises to-day is that the salesmen and engineers from America have not made a study of the manners and customs in these parts, insisting rather that the people should conform to *their* customs. It is through this that the English and the Germans to a large extent control this field. The Latin-American does his business in his own peculiar way, and while it is not our way, yet it will prove vastly more profitable to study this way and meet it, than try to force him to ours. Long credits and a leisurely method in following out an idea is his motto, and our German and English cousins by conforming to his ideas have succeeded, while our men with their "push" and determination to "rush" things have failed through the very thing that has brought them success in other parts. Let them cultivate patience and make a study of the people and their customs and manners, and be willing to devote a month where they are accustomed to spend a week in arranging a sale or a contract; and in the matter of credits and terms, meet the foreign manufacturer on his own ground, and then backed by the superiority of American machinery their reward will be rich and the foothold obtained lasting.

The Development of the Bituminous Macadam Pavement.

In a paper, on the subject named in the heading, read by Mr. Fred. J. Warren at the last meeting of the American Society of Municipal Improvements, the author remarked that the name bituminous macadam may be considered too nearly descriptive to be controlled by any one interest or to be a trade name but, as far as the writer is aware, it was coined for use in connection with letters patent governing methods and proportions of mixing various size mineral ingredients with bitumen, for paving purposes, and in noting the development the writer will confine himself to the experiences of Warren Brothers Company, who control these patents. The name was selected by the promoters of the pavement as descriptive of its construction, combining, as it does, the best features of the asphalt or bituminous pavement and macadam. In some respects, however, the selection of the name is an unfortunate one, as it has given the impression, in some cases, that it is a cheap pavement, and in others that it is like macadam, which in some localities is very unpopular. Extreme cheapness is not claimed to be one of the advantages of the pavement and it is being presented to the public on its merits and not as a cheap pavement. In appearance it is not, on casual observation, materially different from asphalt, but on close examination the particles of stone which afford the more secure foothold can be seen on the surface but held firmly in place by the bituminous cement.

As explained in a paper read before the Boston Society of Civil Engineers early this year by the writer: "The principle on which the bituminous macadam pavement wearing surface is combined is the reverse of the principles on which the ordinary asphalt pavement is built. In the present asphalt or tar pavement the bituminous cement is used to support fine mineral grains, such as sand, which in themselves have no firmness to sustain traffic, in such a way that the fine mineral grains will be held or supported by the bituminous cement so that the mortar

or mastic will, at all atmospheric temperatures, sustain the weight of traffic and, at the same time, resist abrasion. The bituminous macadam is built on the principle that, independent of the bituminous cement, relatively coarse and fine mineral grains should be combined in such a way as to have a firmness in themselves to sustain the weight of traffic. The bituminous cement is supported or held in place by the proper arrangement as to size of stone particles. The bituminous cement is used solely for the purpose of preventing attack on the stone from water and weather, and to bind the particles together sufficiently to prevent abrasion from traffic at all atmospheric temperatures and at the same time provide an elastic bituminous cement or cushion between the mineral particles which will deaden the jar and prevent the wearing effect caused by friction from the movement of the integral parts."

Something over two years ago, after an experience covering a period of 20 years in the refining of asphalt, manufacture of bituminous cement and the laying of asphalt pavements, the idea occurred to one of the Warren Brothers that by combining the essential principles of the most improved asphalt or bituminous and the most improved macadam pavements, a result could be reached which would: (a) Give a pavement with greater durability than asphalt. (b) Provide a foothold for horses equal to macadam, and at the same time maintain the relative or general smoothness of an asphalt surface. (c) Overcome the necessary muddy or dusty condition of macadam and provide a pavement that, while having the density of solid stone, at the same time wouldhave great elasticity.

The theories on which the construction is based are:

1. That with solid, well rolled sub-foundation, a thoroughly rolled base of crushed stone, such as is used in the most improved macadam pavement, is practically as good as any foundation. No one ever heard of a well laid macadam pavement failing because of the foundation.

2. That with a rough crushed stone base, coated with hot bituminous cement and a scientifically prepared wearing surface of bituminous concrete made of crushed stone and bituminous cement, the shifting or rolling of the ordinary asphalt pavement can be overcome. This shifting is due to two principal causes: (a) Rolling on the smooth concrete base. (b) Rolling on each other of the particles of fine sand used in the wearing surface of the ordinary asphalt pavement during hot weather when the bitumen or asphalt is in a semi-plastic and fluid condition. This tendency to shift limits the amount of bitumen which can be successfully used in an asphalt pavement to 10 per cent. or less.

3. That by using for the mineral aggregate of the wearing surface angular particles of the hardest available crushed stone, varying in size from about 2 inches to an impalpable powder, in such proportion that the succeeding sizes will fill the coarser voids in the larger sizes, a far greater density could be secured than had previously been attained in either macadam or asphalt pavement construction. To secure the best results it is essential that the crushed stone after heating be separated into several sizes and then mixed by machinery in definite proportions by weight.

4. That by increasing the density and thus decreasing the voids, and by having the bulk of the mineral aggregate composed of coarse angular particles of stone, the voids can be thoroughly filled with bituminous cement, and by using a bituminous cement which is unaffected by water, a thoroughly waterproof wearing surface of bituminous concrete can be produced.

5. That particles of carefully selected, crushed hard stone, held firmly in place by an elastic bituminous waterproof cement, would provide for the wearing surface of a pavement one of the most durable substances known and a sufficiently rough surface to give an ideal foothold for horses.

In inverse ratio, the percentage of voids in the mixture of different sizes of stone used indicates its density or specific gravity. Uniform size particles of any shape or size contain approximately 40 per cent. of voids. Ordinary sand contains from 30 per cent. to 38 per cent. of voids; very seldom as low as 30 per cent. The most carefully prepared mixture of several grades of sand used in the most modern asphalt pavement mixture contains 25 per cent. of voids. The using of graded stone reduces the voids in the mineral mixture and the rigidness of the stone permits of the use of a softer bituminous cement than can be used with sand.

It is owing to minimizing the exposure of the bitumen and the use of a softer bituminous cement which would require more exposure to render it inefficient that it is believed the cement itself will retain its binding or cementing properties longer than would be possible in sand mixtures.

By using crushed stone varying in size from a maximum of two inches to an impalpable powder in exact proportions, as above described, we are able to reduce the voids to 10 per cent. and, by using enough of the bitumen to thoroughly coat all of the particles and fill all the voids, can get a thoroughly waterproof wearing surface. We do not mean by this that it is advisable to wet the pavement excessively. Any paving material will wear longer if dry than wet. Continual moisture or mud on a pavement, combined with the abrasion of steel wagon tires, produces the condition which is employed to saw and plane stone and other hard substances. The bituminous macadam does not entirely overcome this, but by filling the voids with an elastic bituminous cement, which is absolutely unaffected by water, it does reduce the effect to a minimum. Like other forms of pavement, bituminous macadam is in better condition for horse and foot traffic when dry and clean than when wet and dirty. It should, therefore, be frequently cleaned the same as other forms of pavement.

The bituminous macadam surface is so dense and the particles of stone so firmly held in place by the bituminous cement that, even when made of the hardest trap rock, a section of the pavement when chilled and broken will fracture through the stone. In other words, the stone will break before it will cleave from the cement.

With the assistance of an able chemist of large experience in the study and practical use of bitumens and bituminous construction and, by devising considerable entirely new apparatus found necessary, the first nine months of the history of this pavement were devoted to diligent laboratory work to determine the best ingredients and the best combination of them to carry out the theory of the proposed construction. This brought us to the spring of 1901, when the prospects of success seemed sufficiently sure to warrant the seven Warren Brothers (all of whom had devoted their business lives and training in the several branches of the bituminous and asphalt paving business) in dropping their other interests and assisting in the development. During the first year we succeeded in getting small contracts aggregating something less than 25,000 square yards in seven cities of the United States, five of which are within 50 miles of Boston. Laid with inadequate equipment and crude ideas of detail some of this work, while generally satisfactory, does not fairly represent the possibilities of construction.

The attention attracted by the samples laid in 1901 was far beyond the expectations of anyone and early this year it was realized that much trouble would be encountered in executing work contemplated, and orders were placed in January for seventeen plants of an entirely improved pattern and with a capacity of 1,500 yards a day each. These plants were all of a modern type of rotary drums, elevators, elevated screens and bins which would separate the stone into six different sizes and scales which would weigh each separate size of stone. The work of getting the plants out of the shop as fast as desired was an impossible undertaking and the wet weather of early spring and summer made it impossible to have work well underway until after August 1. It became evident early in the present year that, to cope with the demand a large increase in capital, equipment and practical working force was essential. The result has been that the work constructed and contracted for during the present year amounts to 620,900 square yards in 39 cities.

In one respect the development has been a disappointment to its promoters, and that is in the matter of cost of construction, which proves to be as great as, and in some localities greater than that of asphalt. This does not warrant the taking of more contracts at the prices of some of the earlier contracts taken. The bituminous cement and stone in the bituminous macadam base cost practically the same as the hydraulic cement and stone in the hydraulic concrete foundation of the asphalt pavement, so that the only saving in cost of foundation is the sand and part of the labor employed in mixing concrete.

The crushed stone used in the wearing surface generally costs twice and sometimes three times as much as the sand used in asphalt pavement construction. The bituminous and stone mixture used in the wearing surface of the bituminous macadam is so much more dense and tough than the sand mixture of the asphalt pavement that the time, labor and power required to properly mix the ingredients and handle the mixture on the street are, with bituminous macadam, fully double that of asphalt. This is a condition which we did not foresee. Like all forms of construction the cost varies, very much depending upon the local cost of labor and materials, size of contract and other local conditions.

One important thing which has been developed to a certainty is that bituminous macadam can be laid with special design to provide a rough surface so as to afford a good foothold for horses on very steep grades. In the city of Pawtucket, R. I., the pavement has been in successful use since May, 1901, on a street with a grade of 12 per cent., and has received the unanimous indorsement of engineers and practical road builders who have critically examined it. The Massachusetts Highway Association devoted its quarterly meeting, held in May last, to the examination

and consideration of this pavement. I take the liberty of quoting from the remarks of Mr. J. E. McClintock, of the Massachusetts Highway Commission, made at that meeting: "It has unquestionably solved the problem of pavement for steep grades, and if its cost were double what is asked for it, it would be the most economical pavement for such conditions."

[Concluded from Page 515.]

The Beaumont Oil Fields.

By Mr. Robert T. Hill.

The wells on Damon's Mound encountered small flows of oil at depths of from 400 to 600 feet, exactly as at Beaumont, but so far they have been unsuccessful in securing a commercial flow.

At Keyser's Mound, in the same county, about 6 miles north of Damon's, and near the Brazos river, a flow of oil was struck at about 400 feet, but unfortunately the drillers were unable to cut off a tremendous flow of artesian water which was encountered just above it, and, as a result, the well produces to-day a remarkable emulsion of oil and water.

The well at Velasco (Bryan Heights) struck, at about 600 feet, a flow of gas so violent that its roar could be heard for miles. As a gas well, this was as remarkable a phenomenon as were the Spindle Top oil "gushers." The flow of gas could never be controlled; the well had to be abandoned, and a new hole, started beside the old one, is now giving every indication of securing oil.

Proceeding southward throughout the vast desert of the Lower Rio Grande, small quantities of oil have been encountered at several places, while still farther southward, at the end of our Coastal Plain, some miles from Beaumont, authentic reports have recently been received that flowing wells have been developed at Tampico, Mexico. Even as far south as the State of Tobasco two flowing wells are reported. These results of a single year, although still fragmentary, are sufficient to reinforce our belief that in the future years the Beaumont field will furnish other profitable localities of commercial oil besides Spindle Top.

A Year's Development.—On January 10, 1902, one year from the date of the discovery of oil, there were 136 wells on Spindle Top. Operations for the first 3 months of the second year show a great increase; the number of "gushers" has grown from 136 to 214, and more wells are drilling at present than at any previous time.

Three pipe lines have been finished, two to Port Arthur (19 miles) and one to Sabine (24 miles). Pipe lines from Beaumont to New Orleans, and Beaumont to Galveston, Houston and other Texas points, are contemplated.

On March 1 the tank storage exceeded 5,000,000 barrels. Among the tanks of 37,500 barrels capacity and over were 22 at El Vista, 28 at Gladys, and 33 at Port Arthur.

The demand for tank cars has constantly increased. In February, 1902, 500 cars were added, making a total at that time of 1,500. The Southern Pacific Railway has since purchased 250 tank cars of 12,850 gallons capacity each, and many of the cars have already arrived at the loading racks. Many companies now have ample shipping facilities. In addition to the regular tank car lines, there are between 800 and 1,000 tank cars owned by local oil companies. A huge tank car factory is being erected at Beaumont to supply the demand.

Tank steamers also have been in great demand. Many ships have cleared from Port Arthur, but the supply nowhere approximates the demand. The Guffey Company is constructing five steamers, one of which, to carry 60,000 barrels, is the largest ever made in America, and will equal any in the world.

The Guffey Company already has two refineries completed at Port Arthur, and another approaching completion. Work on five other refineries is progressing rapidly. Guffey Refinery No. 3, at Port Arthur, will have a capacity of 2,500 barrels per day. This Company will ship no crude oil, but will bring the flash point up from 120° to 145° and 150°, by taking out naphtha and kerosene, before shipment.

Within a year from its discovery, Beaumont oil is burning in Germany, England, Cuba, Mexico, New York and Philadelphia. By its energy steamers are being propelled across the ocean, trains are hastening across the continent, electricity is generated and artificial ice frozen in New York, ores are ground and stamped in Mexico, Portland cement is manufactured in Havana and Texas, and gas enriched in Philadelphia; and this, too, while half the world is either unaware or incredulous of the value of this fuel.

A strong demand for the oil comes from the manufacturers of illuminating gas. In March, this demand from New York and Philadelphia was great enough to justify a daily steamer from Port Arthur to those cities. The oil is also being sent to Atlanta and other cities for this purpose.

Many of the great railway lines of Texas have changed or prepared to change from coal to oil as fuel for their locomotives. The oil is also being used in hundreds of small factories in Texas, such as breweries, brickyards, etc. Even the farmers are using it as a fuel sufficiently inexpensive to permit of pumping for irrigation.

The production of the Beaumont oil field during its first year was limited for the lack of means of distribution. It is estimated, however, that 5,500,000 barrels were actually drawn from the great reservoir—one-half of which was stored in tanks and the remainder consumed, shipped or wasted.

The shipments for 1901 were 1,750,000 barrels; for the first 3 months of 1902 they exceeded that total, those for March alone being more than 800,000 barrels. The field will probably ship 20,000,000 barrels in 1902. It is estimated that the development of this field has cost $7,000,000, of which about $1,250,000 has been paid for labor. The tubing and well-drill rigs have cost, approximately, another million. Pipe lines, lumber for derricks, and tanks for storing the oil have consumed the remainder.

The average cost of sinking a well at Spindle Top is $7,249. The 215 wells that are "in," together with the adjacent "dusters," have cost fully $2,000,000. Probably $50,000,000 more has been expended for purchase of land, transportation facilities and other legitimate purposes. The capitalization of the 200 companies in the field is placed at $200,000,000.

Before Capt. Lucas's well came in, land could be purchased anywhere in the Coast Prairie country for less than $4 an acre. Millions of acres have since changed hands at fabulous prices, while every foot has been leased for favorable considerations. Thousands of acres of this land 150 miles from Beaumont have sold for as much as $1,000 per acre. Land within the proved field has sold for nearly $1,000,000 an acre, $900,000 having recently been paid for one acre. No sales were made for less than $200,000 per acre. Spindle Top to-day may be justly assessed at a valuation of $500,000 an acre, or $100,000,000. Two years ago it could have been bought for less than $10 an acre.

The 214 wells upon the field are owned by about 100 companies. It is estimated that 120 of the wells are located upon 15 of the 200 acres of productive territory. These wells are in the hands of nearly as many individual companies, mostly small organizations without means for operation or facilities for outlet and transportation. The remainder of the territory is within the hands of four or five legitimate operators, who not only possess wells, but tank cars, pipe lines, refineries, etc., for handling and marketing the oil.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. James Bowen has resigned from the service of the Pottsville (Pa.) Gas Company. Mr. W. L. Glass will have charge of the manufacturing division of the Company's business, and will act as its Manager as well. As said before in the Journal the Pottsville plant is now controlled by the syndicate which operates the Wyandotte Gas Company, of Bethlehem, Pa.

Mr. Geo. McLean, of Dubuque, Ia., and his associates have declined to accept the franchise offered them by the authorities of Cedar Falls, Ia., for the establishment of a gas works at that place. The point of difference in the main is the life of the grant; the authorities put the same at 20 years, but the petitioners insist on a period of 25 years.

General Manager John J. Cummins, of the Syracuse (N. Y.) Lighting Company, had much reason for self-congratulation recently when the Directors of the corporation had completed their inspection of its gas and electric lighting divisions. Everything in each was up-to-date, and the discipline of the establishments as shown in and by the working force, seemed especially to merit the approbation of Messrs. Pruyn and Peabody. Manager Cummins has planned some notable extensions to the main system, which will be carried out next spring.

We understand that the proprietors of the Peoples Gas and Electric Light Company, of Xenia, O., which is the result of the late merging of the gas and electric interests of that city, are in the market for proposals for the reconstruction of the gas plant.

THE syndicate headed by Messrs. Brown and Mayer, of Chicago, that recently secured control of the plants of the Baraboo (Wis.) Gas and Electric Light Company, proposes to install there a new coal gas plant. Mr. B. H. Strong will be retained in the position of Manager.

THE proprietors of the Negaunee (Mich.) Gas Light Company are asking for a 30-year extension of their franchise. In case the authorities assent to the proposition (and there is little fair cause for believing that such assent will be withheld) the works will be rebuilt.

THE Chicago *Inter-Ocean* is our authority for the statement that the Directors of the Peoples Gas Light and Coke Company, of Chicago, are planning to build an extensive plant on coal gas lines.

A CORRESPONDENT forwards the following from Bloomington, Ills., under date of the 11th inst.: "Plans have been finally accepted for the new building of the Union Gas Company, which is to be erected on North Main street. The building, which is to have a dimension of 23 feet by 90 feet, and 3 stories in height, will be one of the handsomest in the city, will have a new feature in the shape of a divided party wall on one side, a 4-foot space allowing side light to the second and third stories and skylight for the first story, the court extending to within a few feet of the sidewalk. Two first stories will be of iron and plate glass and the top story will be a sort of Romanesque design in terra cotta. The office will be as handsome as that of any bank, and will have the Cashier's and bookkeeper's inclosed desks, in front with a side passage to the rear where are the Directors' room, and the show room. There are also stenographer's private office, Manager's office, toilet rooms and vault on this floor. The prism glass will add to the lighting facilities. The second story will be a workshop and the third floor and basement will probably be used for storage. The Company will use the entire building. Work will begin as soon after the specifications are completed as possible."

SUPERINTENDENT A. F. BIGELOW, the wideawake "managing man" of the Allentown (Pa.) Gas Company, has been obliged to largely increase the generating capacity of that well-managed plant. It is likely that he will shortly be in the market for an additional holder, so great has been the demand for gas in Allentown since the beginning of the year.

MR. FRANK D. MOSES, Chief Engineer of the South Jersey Gas, Electric and Traction Company, since the organization of that concern, has resigned from its service. His resignation was followed by that of Mr. Richard Stockton, whose position in the Company was assistant to its President, Mr. A. R. Kuser. Mr Moses will not remain on the waiting list for a lengthy period, as the columns of the JOURNAL will shortly show.

A CORRESPONDENT forwards the following from LeRoy, N. Y., under date of the 11th inst.: "Another result of the coal strike is being felt in LeRoy at present. It is an increase in the price of gas and it does not strike the people very favorably. Those who are without coal and have gas piped into their houses had contemplated using gas more than ever this fall and during the winter if coal could not be procured. The price for fuel gas has been until now $2 per 1,000 with a discount of 50 per cent. if paid before the 10th of the month, which made it $1 net. Now the price is $2.50 per 1,000 and a discount of 20 per cent., which makes the net price $2 per 1,000."

MR. E. W. BATCHELLAR, formerly Purchasing Agent for the Denver (Col.) Gas and Electric Company has been appointed permanently as General Manager of the San Antonio (Tex.) Gas and Electric Company, which position carries with it the duties incident to the management of the San Antonio Traction Company.

THE incorporation of the Arkansas Gas Company of Little Rock, Ark., is announced. It is capitalized in $100,000, and its sponsors are Messrs. W. W. Hippolite, G. A. Pleus and G. W. Hudspeth. No one knows just yet what its promotors are aiming at.

ACCORDING to the Boston (Mass.) *Evening Herald* the Massachusetts Board of Gas and Electric Light Commissioners, in response to the petition of the Springfield Gas Light Company for permission to increase its capital stock to the sum of $250,000, has issued an order stating that the additions and improvements for which the stock is asked have cost about $210,000; that the Company has in its treasury funds to the amount of $100,000 which may properly be applied to meeting part of the cost of these improvements, and that it, therefore, approves the issue of 500 shares of new stock at a par value of $100 per share, which is to be offered to stockholders of the Company at $200 per share, any stock not subscribed for to be offered at public auction in Springfield.

"F. H. S.," WRITING to the JOURNAL under date of the 9th inst., incloses the following from San Francisco, Cal.: "Changes that will cost the U. S. Government not far from $90,000 are now being made in the local mint. For the past 5 months Master Mechanic George McLaughlin, who has been in the employ of the Treasury Department for many years and has superintended the installations of the machinery in all the mints in this country, has been at work removing the old machinery, which has been in use since the opening of the mint in San Francisco in 1874, and replacing it with more modern machinery and appliances. The changes will tend toward the making of coin at a more economical cost to the Government and will also materially lessen the uncleanliness and dirt which have heretofore been caused by the old and antiquated machinery. All bullion will hereafter be melted by the use of gas instead of coal and coke. This method is much cleaner and cheaper and will lessen the liability of waste. It will not do away with the employment of any of the mint employees."

THERE is probably no one thing that will do more to make the Universal Exposition at St. Louis successful than the fact that it is to be held in 1904. This is particularly true as applied to the Department of Manufactures of the Exposition because of the unprecedented activity in all lines of industry that will be represented in that department. In the last 50 years, according to the Government census reports, the increase in the capital invested in manufacturing approximates nineteen-fold (533,245,351 to 9,874,664,087); the average number of wage earners about six-fold (957,059 to 5,321,087); the value of products about thirteen-fold (1,019,106,616 to 13,040,013,638); and the value of wages paid about ten-fold (236,755,464 to 2,330,273,021). The percentage of increase from 1890 to 1900 was, in capital invested, 51.3 per cent; number of wage earners 25.2 per cent.; value of products 39.1 per cent.; wages paid 23.2 per cent. With this unprecedented volume of business existing it is fair to presume that the participation of the manufacturers in the Universal Exposition at St. Louis in 1904 will be on a very elaborate scale as compared with any previous World's Fair—the last one, at Chicago, occurring as it did during the panic of '93. It is conservative to say that the attendance in St. Louis in 1904 will fully reach the expectations of the most sanguine, when the prosperity of the country is considered and it is realized that, for the first time in many years, the great middle class is earning sufficient to pay its way to an exposition without drawing on its savings account. The apparent value of the products per wage earner has increased since 1850 from $1,065 per year to $2,451, and a large percentage of this increase has been achieved during the last 10 years. It is quite evident, therefore, that conditions point to the year 1904 as an excellent period for an exposition and the St. Louis Exposition authorities are to be congratulated upon their choice of this time in which to celebrate the important event of the Purchase of the Louisiana Territory.

"F.," WRITING from Houston, Tex., under date of the 13th inst., says: "Mr. Walter E. Mockett has resigned his position with the United Gas Improvement Company to accept the management of the Dallas (Tex.) Gas and Fuel Company. Mr. Mockett will sever his connection with the U. G. I. Company, November 1st, after a continuous service with it of more than 14 years. He served it mainly in the engineering and construction departments. The Dallas Company is to be congratulated on securing so capable a successor to its former able and popular Manager, Mr. Thos. D. Miller, now Manager of the New Orleans Lighting Company."

PROF. J. TROWBRIDGE, of Harvard, asserts that lightning does not strike water. This discovery he has made in his experiments with the highest electromotive force ever used. By means of his battery of 20,000 cells he obtained a voltage of 6,000,000, which force, he says, is at least comparable to lightning, and enabled him to deduce his conclusions. "I found that lightning does not strike water," says Prof. Trowbridge, "in the course of my experiments on the effect of high tension or high electromotive force. With my large battery I was able to obtain an electric spark about 7 feet long, and found that instead of striking the water a spark of 6 or 7 feet in length invariably jumped to some adjacent object in preference to striking the liquid surface. A spark of only a few inches in length, however, invariably will strike the water, but such a spark is not, of course, comparable to lightning."

THE AMERICAN GAS LIGHT JOURNAL

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Notification Respecting Advertising.—Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, SEPTEMBER 20, 1902.

(*Continued from page* 553.)

IT is understood that the properties of the Princeton Gas Light Company, the Princeton Electric Light Company and the Hopewell Electric Light, Heat and Power Company, all of Princeton, N. J., have been merged. The name of the undertaking concern is the Princeton Lighting Company, and the chief parties in interest are Messrs. Samuel H. Blackwell, C. P. Fitch and the firm of La Barbier & Parker.

THE Essex and Hudson Gas Company, of Newark, N. J., has completed the extension of its distributing system through the bustling borough of Parkview.

THE American Gas Engine Company has arranged for the removal of its shops from Sheboygan Falls, Wis., to Green Bay, Wis.

THE new storage holder for the Consolidated Gas Company, of Baltimore, Md., intended for the better supply of the Canton district of that city is in effective working order much to the relief of the engineers of the Company and to the better satisfaction of the Cantonese. Its capacity is 1,000,000 cubic feet. The Company has a 3,000,000 cubic foot holder under way.

THE Staunton (Va.) Gas Company has issued a mortgage in the sum of $75,000 six per cent., coupon gold bonds, which covers all its properties, which include those of the hitherto independent electric lighting concern. The Company's officers are: President, E. M. Funkhouser; Vice-President, S. D. Ferguson; Treasurer, M. N. Bradley.

The Market for Gas Securities.

The seeming termination of the coal strike, after its long and wearing dragging out, together with easier conditions in the money market, will easily explain the strong advance in all sorts of securities dealt in on the Exchange. Last Friday the closing for Consolidated was 216 to 217; this Friday (the 17th) it was 220½ to 221. The strike and its consequences are not altogether unmixed evils for the gas companies of the country, since the scarcity and high price of solid fuels have taught many housekeepers who tried gas as a substitute lessons in favor of the latter that will hereafter keep them permanent users of gaseous fuel. The increased business that has been done and that is now being done by the Consolidated Company simply balks belief.

Brooklyn Union shot up to 233 bid, 238 asked, a gain for the week in the quoted value of 8 points. Peoples, of Chicago, is up to 105, and in fact every gas stock has had sharp recoveries from the abnormally depressed values of a month or so. During the week, at the annual convention of the American Gas Light Association, which was held this year in New York, it would cause the layman much wonder over the stories regarding how the local residents acted towards the gas companies during the strike period as against the action of the same residents during no strike times. The stories were true, too.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

OCTOBER 20.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	220¼	221
Central Union, Bonds, 5's.	3,000,000	1,000	110	112
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	350	..
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	112½	113
Northern Union, Bonds, 5's.	1,250,000	1,000	108	110
New York and East River .. Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	342,650	50	100	..
" Bonds	100,000	1,000	103	
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,650	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	233	238
" " Bonds (5's)	15,000,000	1,000	119	119½
Bay State	50,000,000	50	1¼	1⅝
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	10½	11
" " Bonds, 5's	5,254,000	1,000	79	81
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	100⅛	100¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	73¼	73⅝
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	.	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	.	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	961,000	1,000	77	79
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	80
" Bonds, 6's	2 650,000	..	102¾	104½
Jackson Gas Co	350,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	90
Preferred	2,500,000	100	..	110
Bonds	10,000,000	1,000	109⅛	110
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	112	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	110½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	218	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	104⅜	105
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	48	48½
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	93
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	95	96½
Syracuse, N. Y.	1,975,000	100	29	..
Bonds	2,047,000	1,000	99¼	100
Washington, D. C	2,500,000	20	37½	..
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	109½	110
Wilmington, Del.	600,000	50	232	..

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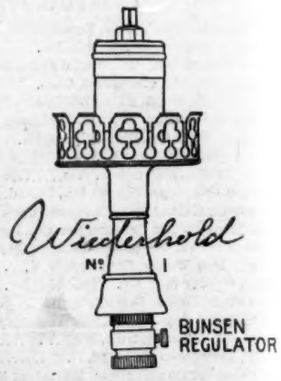

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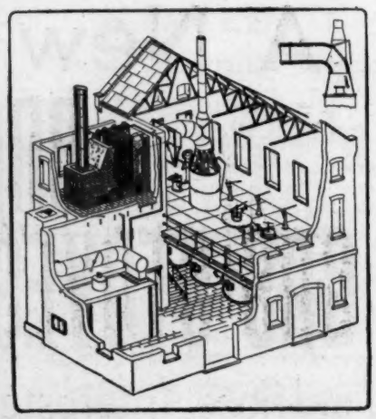

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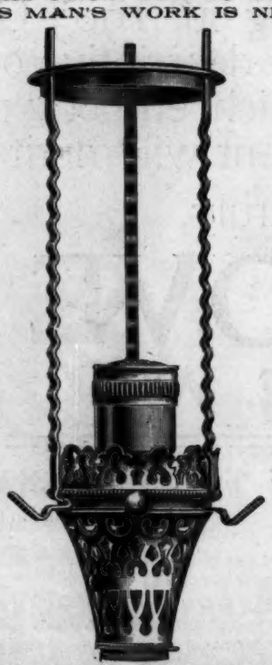

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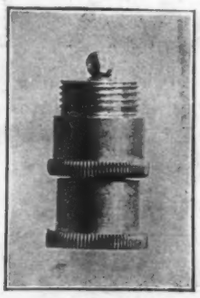

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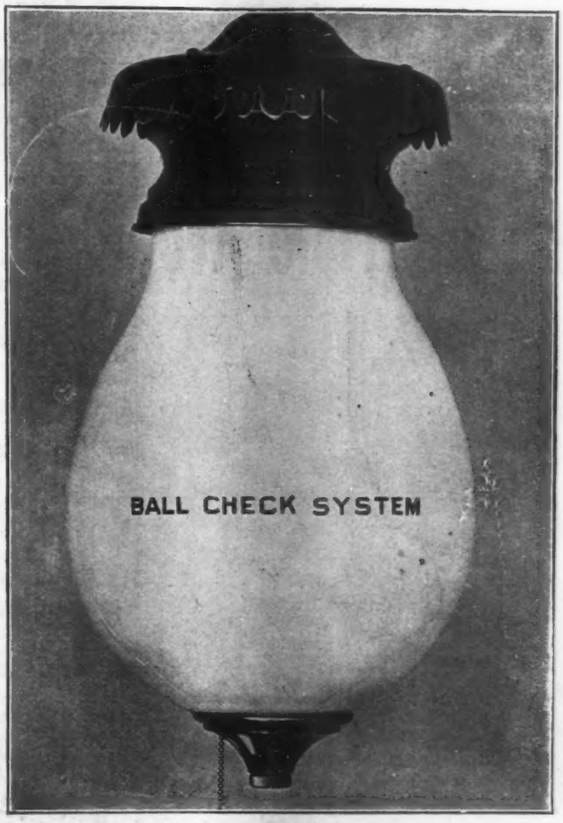

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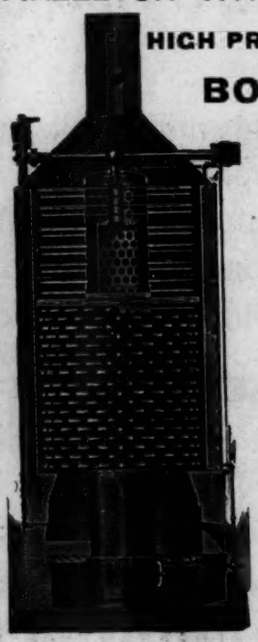

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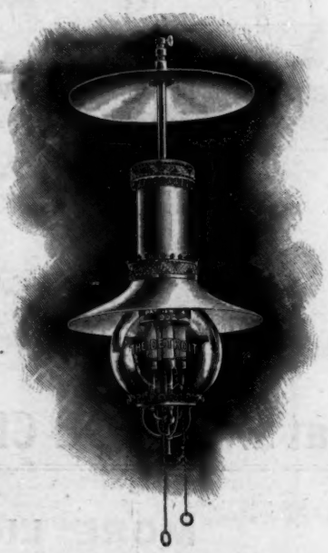

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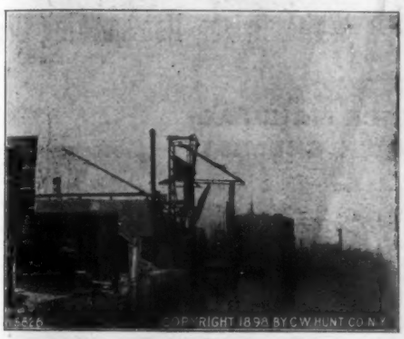

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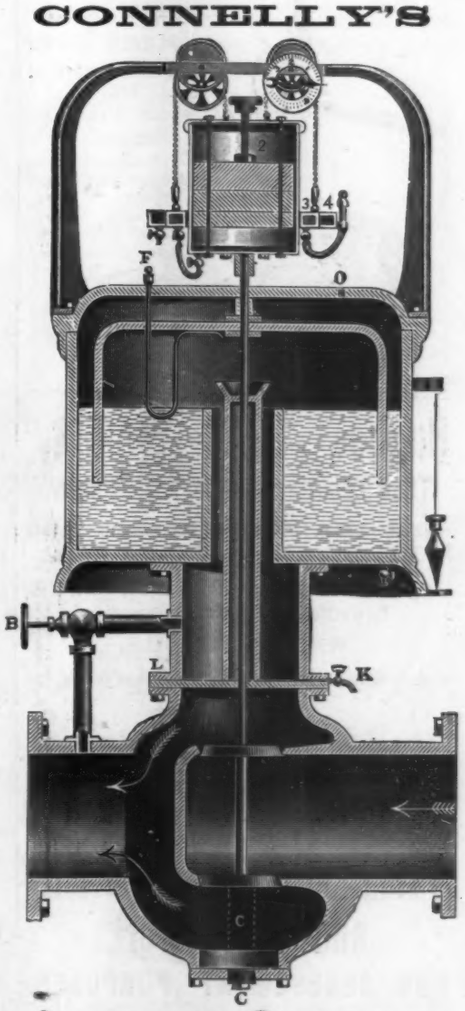

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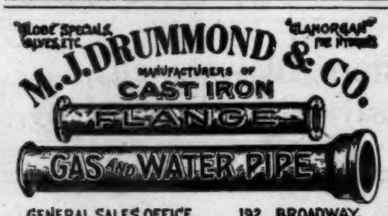

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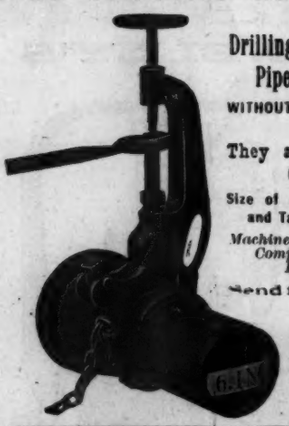

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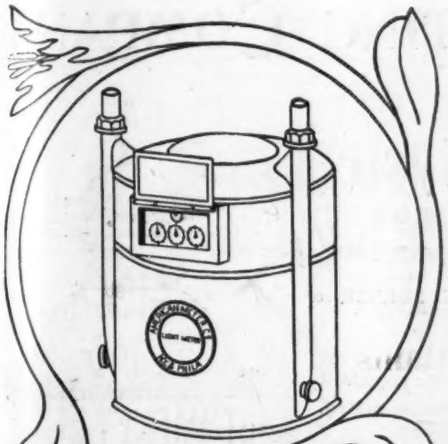

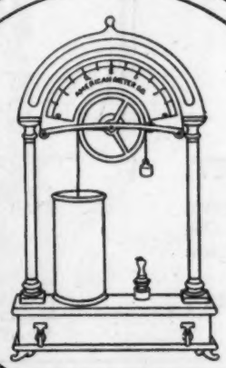

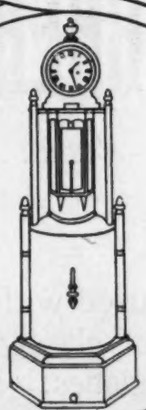

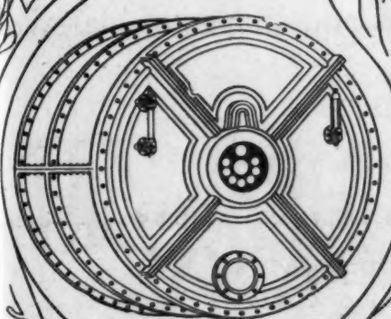

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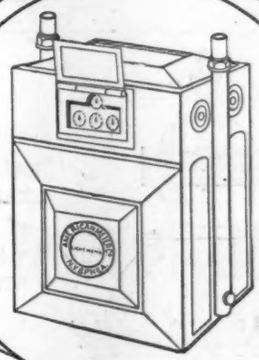

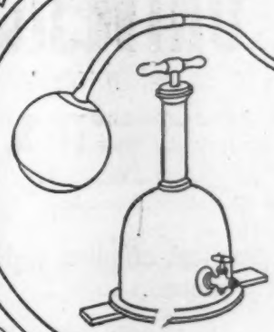

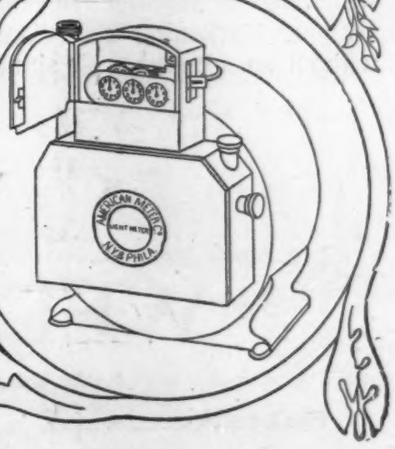

PUBLIC LIGHTING TABLE.

NOVEMBER, 1902.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	5.30 PM	5.30 AM	4.45	5.35
Sun.	2	5.30	5.30	4.45	5.35
Mon.	3	5.30	5.30	4.45	5.35
Tue.	4	7.20	5.30	4.45	5.35
Wed.	5	8.10	5.30	4.40	5.45
Thu.	6	9.00	5.30	4.40	5.45
Fri.	7	10.00	5.30	4.40	5.45
Sat.	8	11.00 FQ	5.30	4.40	5.45
Sun.	9	12.00	5.40	4.40	5.45
Mon.	10	1.00 AM	5.40	4.40	5.45
Tue.	11	2.00	5.40	4.40	5.45
Wed.	12	3.10	5.40	4.30	6.00
Thu.	13	4.20	5.40	4.30	6.00
Fri.	14	No L.	No L.	4.30	6.00
Sat.	15	No L. FM	No L.	4.30	6.00
Sun.	16	No L.	No L.	4.30	6.00
Mon.	17	5.10 PM	7.50 PM	4.30	6.00
Tue.	18	5.10	9.00	4.30	6.00
Wed.	19	5.10	10.10	4.25	6.00
Thu.	20	5.10	11.10	4.25	6.00
Fri.	21	5.10 LQ	12.20 AM	4.25	6.00
Sat.	22	5.10	1.30	4.25	6.00
Sun.	23	5.10	2.30	4.25	6.00
Mon.	24	5.10	3.30	4.25	6.00
Tue.	25	5.10	4.30	4.25	6.00
Wed.	26	5.10	6.00	4.20	6.10
Thu.	27	5.10	6.00	4.20	6.10
Fri.	28	5.10	6.00	4.20	6.10
Sat.	29	5.10 NM	6.00	4.20	6.10
Sun.	30	5.00	6.00	4.20	6.10

TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

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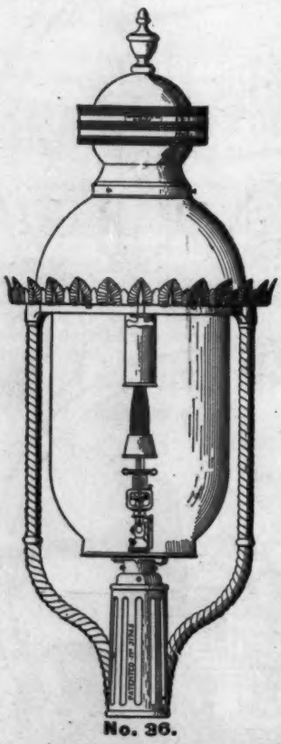

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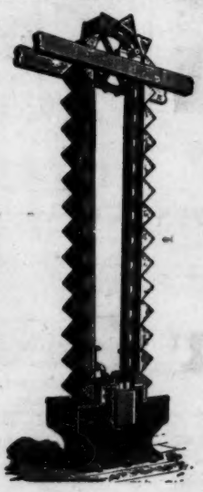

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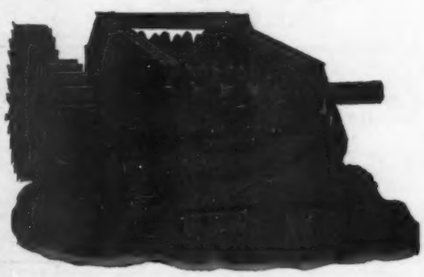

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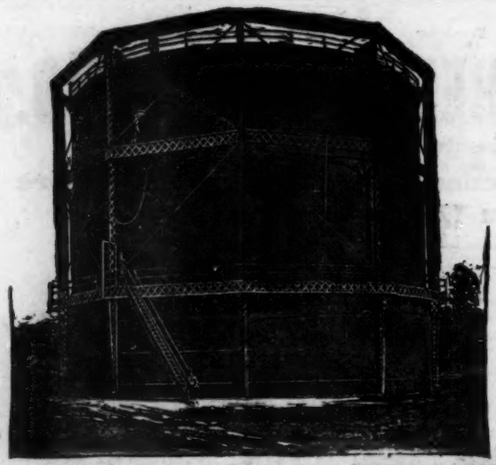

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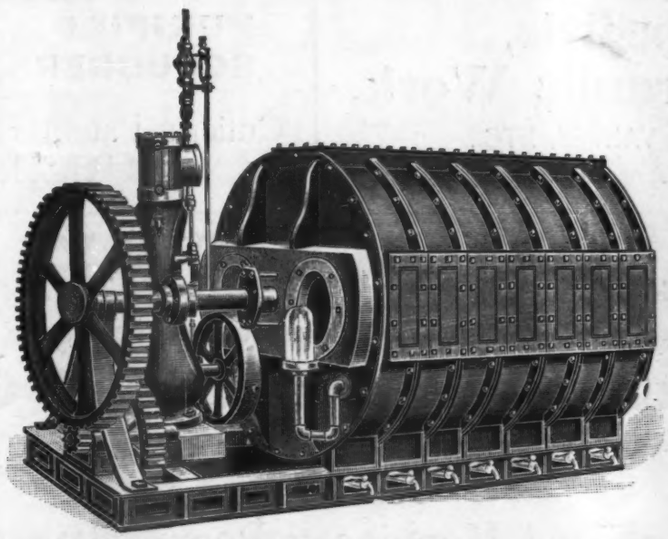

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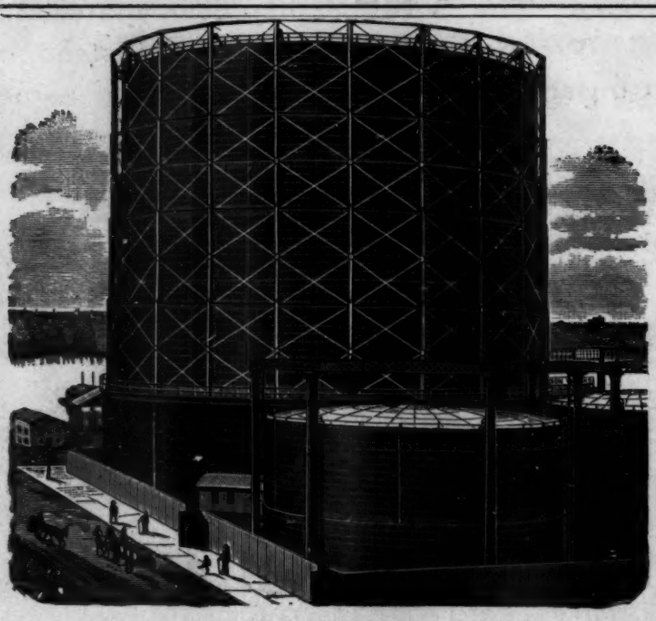

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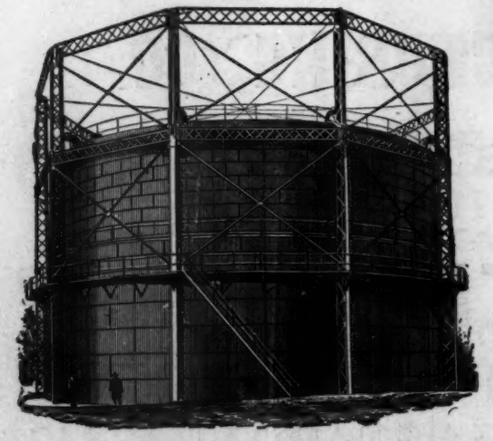

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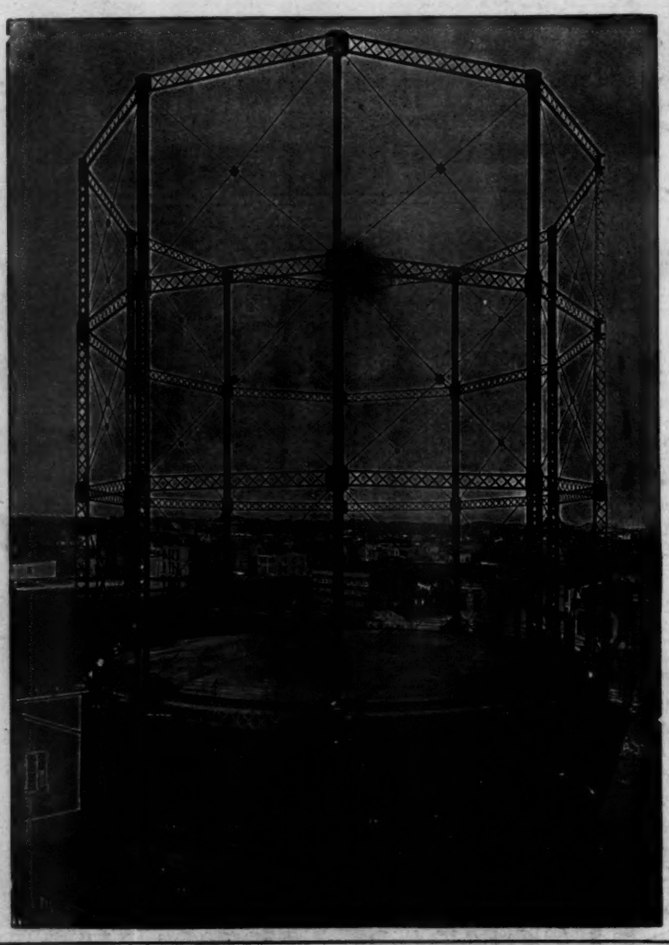

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